Feasibility Study to Consider an Aircraft for the Air Launch and Air Transportation of the Space Shuttle Orbiter

FEASIBILITY STUDY
TO CONSIDER AN AIRCRAFT
FOR THE AIR LAUNCH AND AIR TRANSPORTATION
OF THE SPACE SHUTTLE ORBITER

This Study has been conducted in accordance with
NASA Contract NASW-2627, issued by
NASA Headquarters, dated February 28, 1974.

For Additional Information, Please Contact:

John M. Conroy, President
Turbo-Three Corporation
P. O. Box F
Goleta, California 93017

Phone: Area Code 805/964-4757

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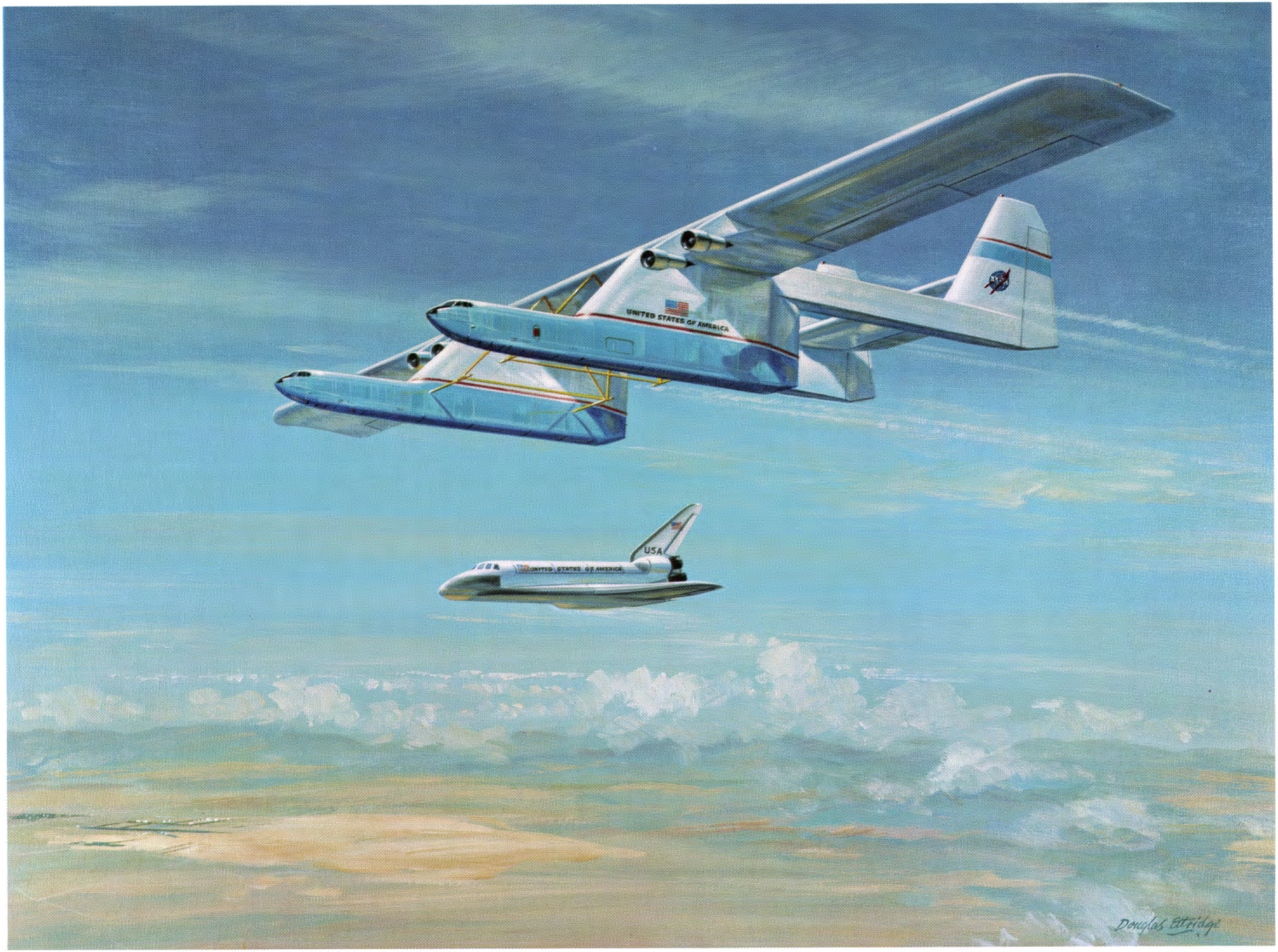
INTRODUCTION

In December of 1973 and January of 1974, Turbo-Three Corporation submitted to NASA unsolicited proposals for an aircraft which was conceived for the primary purpose of air dropping and transporting the Space Shuttle Orbiter. As a result of these proposals, and discussions held with NASA personnel, Turbo-Three Corporation was requested to conduct further study of the feasibility of its proposed concept.

In the preparation of this study, Turbo-Three Corporation contracted with other firms and individuals to assist in areas of engineering, manufacturing concepts, testing procedures, and for artists' conceptual services. The results of the various studies and artists' portrayals of the aircraft, and manufacturing and operational concepts are presented in this study, with the exception of the complete engineering analysis. These data are voluminous and would make this presentation too cumbersome and burdensome for easy reading if presented here in their entirety, therefore, engineering calculations and other technical data are being submitted in the form of an appendix to this study.

In a further effort to keep this presentation brief and at the same time reasonably comprehensive and understandable, we have assumed to be correct the old adage of, "one picture is worth a thousand words", and, therefore, have relied heavily on drawings and artist's conceptions. We are confident that this type of presentation will greatly reduce reading time, which should be appreciated by the readers.


UNITED STATES OF AMERICA
USA
UNITED STATES OF AMERICA

AIRCRAFT CONCEPT AND DESCRIPTION

CONCEPT

In our original proposal, we presented a concept for a hybrid aircraft which combined lighter-than-air and conventional airfoil aerodynamics. Further study, giving particular consideration to the requirement for capability for high altitude operations, revealed that this concept was not feasible with present day technology for the control of helium. Therefore, in January of this year, we submitted to NASA an amended proposal describing a more conventional aircraft which is the subject of this study.

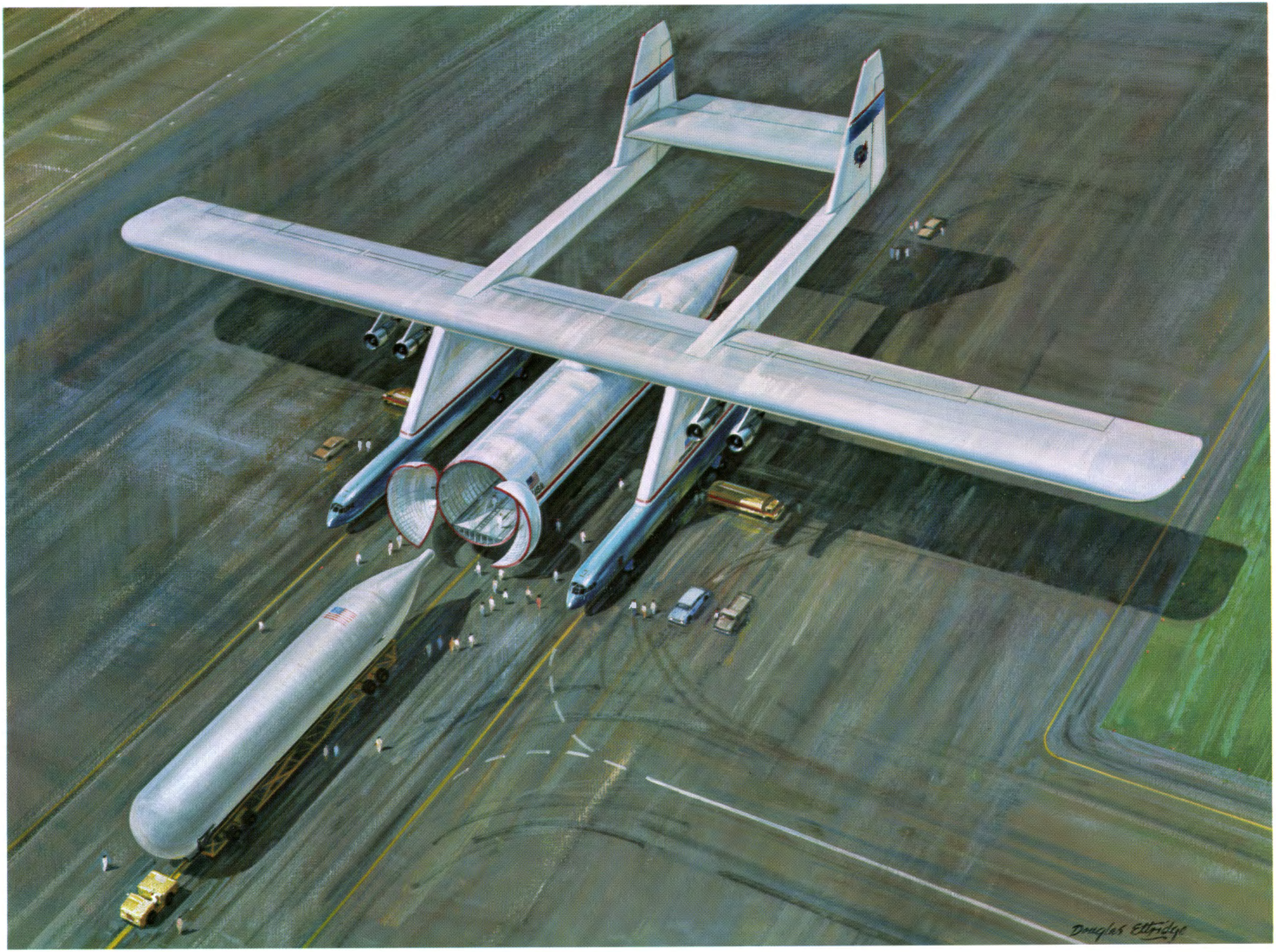
The basic concept was to design an aircraft which would have the capability of performing the mission requirements using proven and accepted engineering and construction techniques and incorporating already manufactured components wherever possible. Primary requirements, which were considered, included the capability to:

1. Safely drop the Orbiter from an altitude of approximately 35,000 feet.
2. Transport the Orbiter coast to coast non-stop, or from the Hawaiian Islands to the west coast of the United States.
3. Operate from normal jet runways (150 feet wide, 6,000 feet long) with no special air field requirements, other than perhaps widening of some taxiways or providing turning and and loading pad locations.

Highly desirable features, which are considered as secondary, included the capability of:

1. Transportation of the external tank (ET).
2. Transportation of two solid rocket booster (SRB) cases.
3. Transportation of other out-sized hardware supporting the Shuttle or other government programs.
4. Air dropping of the orbiter from 40,000 feet or higher.

With these requirements and secondary features in mind, we have improved our original concept and believe that the aircraft described herein is ideally configured and capable of performing all of the missions listed above.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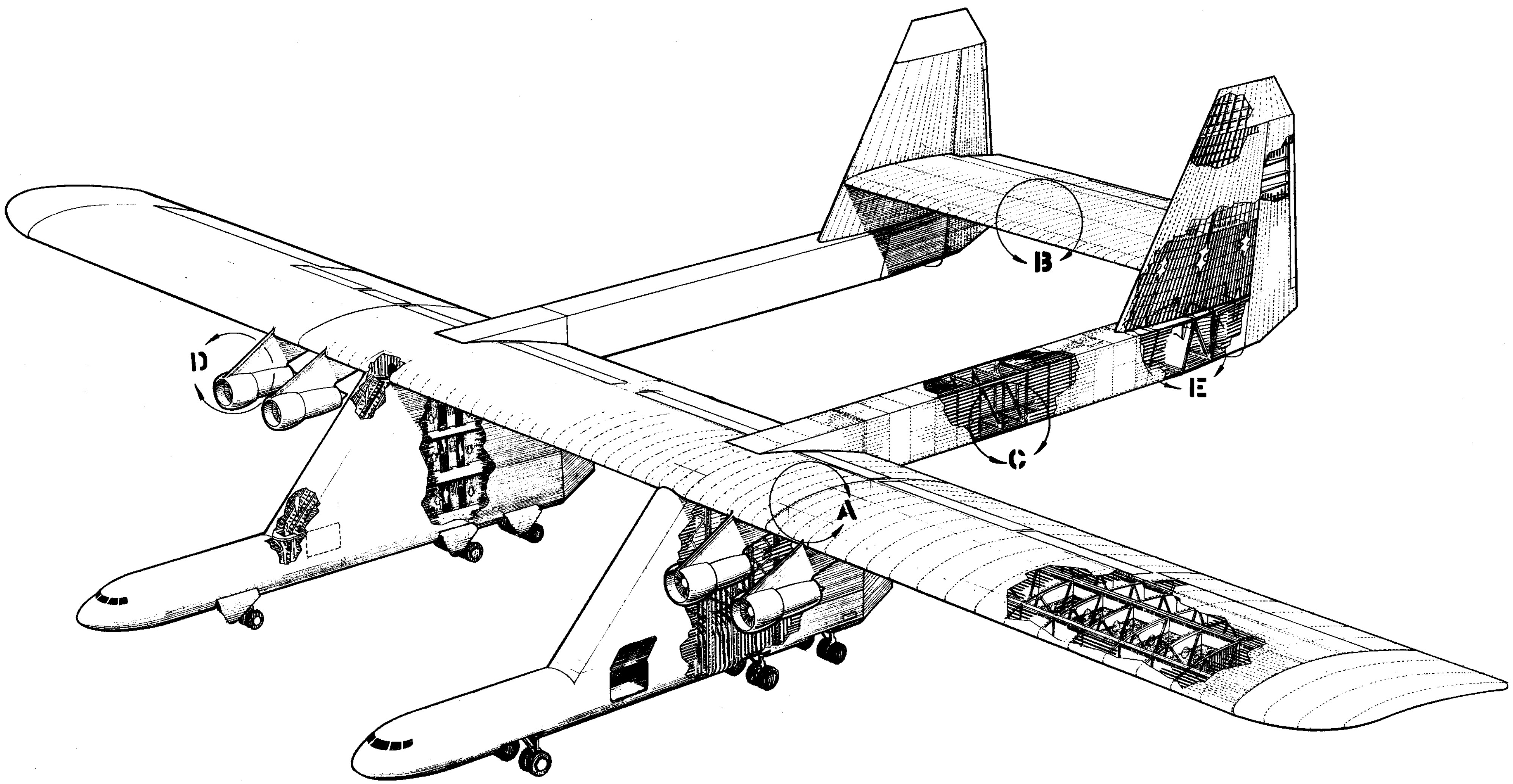

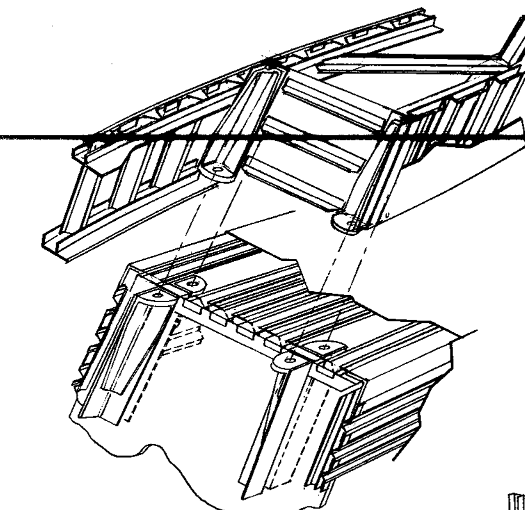

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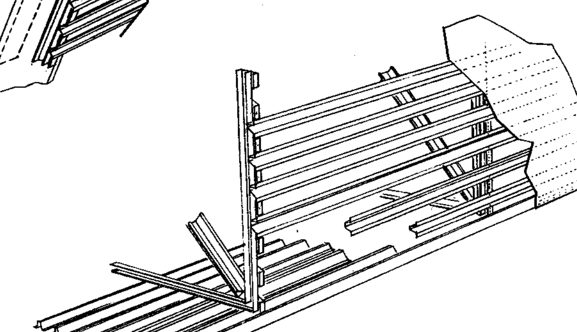

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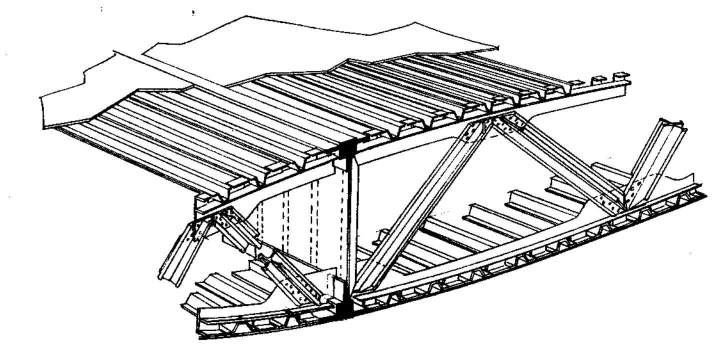

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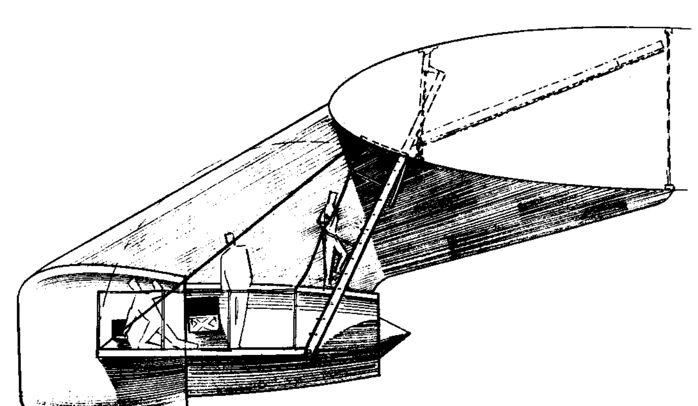

VIEW D
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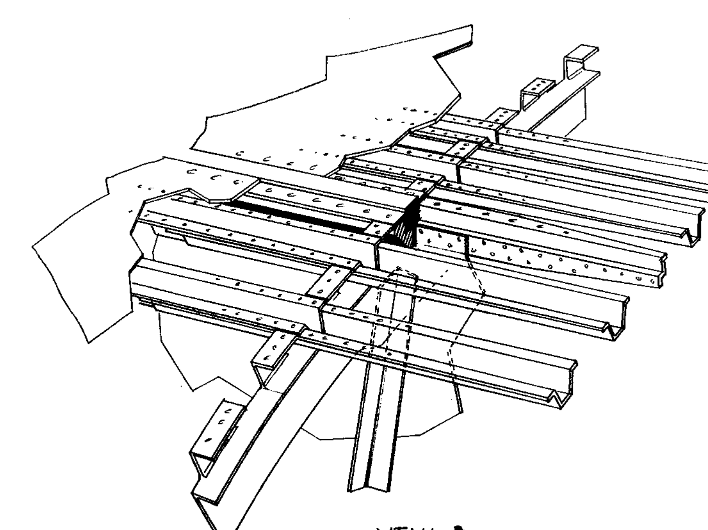


VIEW A

DESCRIPTION

The proposed concept is a four engined, high winged aircraft with dual, slab-sided fuselages and twin tail booms and vertical tail surfaces.

As noted in the concept, we first examined all available aircraft which might be used as a base from which to build our proposed aircraft, placing particular emphasis on being able to utilize an existing cockpit and landing gear. The cockpit and landing gear, including gear actuating systems, wheel wells and doors, are extremely expensive sections in aircraft engineering and construction. Our investigation disclosed that the B-52 provided an ideal platform for our requirements—almost as if it had been designed for the project. The cockpit of the B-52 can be readily configured for a three man flight crew operation with comfortable rest quarters for additional crew members when required. The cockpit on the right fuselage would provide comfortable, pressurized, air-conditioned quarters for technical personnel and cargo monitoring instrumentation, which might be required for any particular mission.

The landing gear is rugged and has a highly unique, well proven system for pre-setting the longitudinal angularity for cross-wind landings. While the weight of our aircraft would not require more than a standard B-52 landing gear on each fuselage, we have added a third set of four wheels to each fuselage. As previously stated, these extra gear are not to meet aircraft structural requirements, but are merely for the purpose of distributing loads in order to minimize runway restricitons. With 24 wheels, the Virtus would be capable of operating from a dirt strip.

Our aerodynamic performance studies have been based on power plants providing a total of 160,000 pounds of thrust available for take-off. With this amount of thrust, the aircraft could utilize any of the present day large fan-jet engines, de-rated to 40,000 pounds each. Higher thrust engines, or the use of one or two extra engines for the air drop missions, would enable the Virtus to attain a drop altitude of 40,000 feet or higher, restricted only by mach limitation of the Virtus airfoil. The remainder of the aircraft structure and systems are conventional and will utilize off-the-shelf hardware wherever possible.

There is a large cargo compartment in each B-52 fuselage for carrying various support equipment.

There are telescoping, retractable stands built into the wings to enable routine engine inspection without requiring ground maintenance stands. Also incorporated would be a traveling hoist on a rail extending between the outboard engines. This would enable lowering and raising of an engine Q.E.C. (quick engine change) to and from ground level, without requiring ground support equipment. There would be a stand-up head room passageway from wing tip to wing tip for ease of inspection and maintenance.

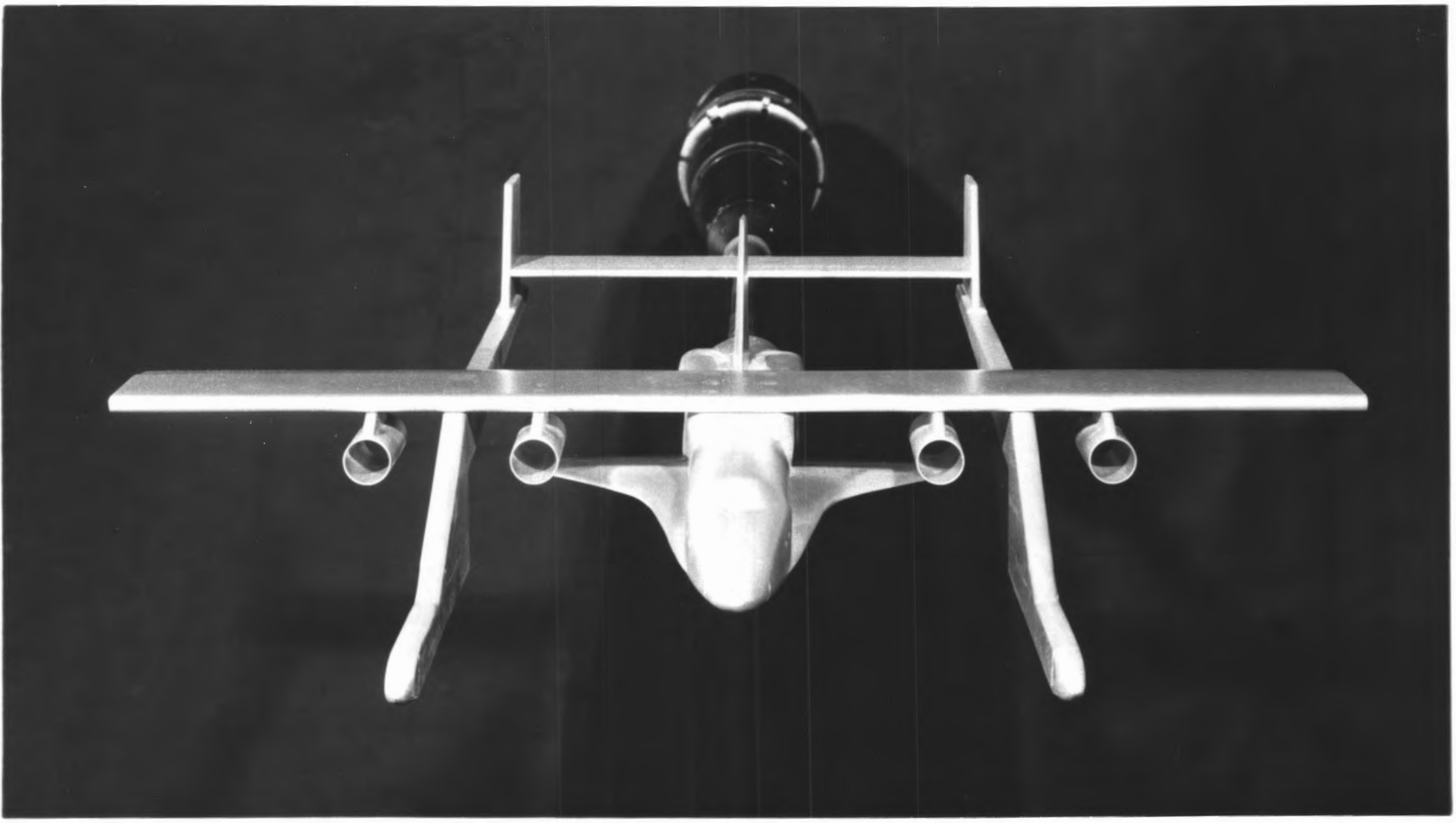
The design incorporates an elevator located in the fuselage pylon section or stairways in the front ends of these sections to facilitate access to the wing center section from the B-52 fuselage. This would also make it possible, while the requirements would be remote, for personnel to move from one fuselage to the other during flight, using walk-around oxygen bottles and employing the 'buddy system' for safety.

ENGINEERING STUDY

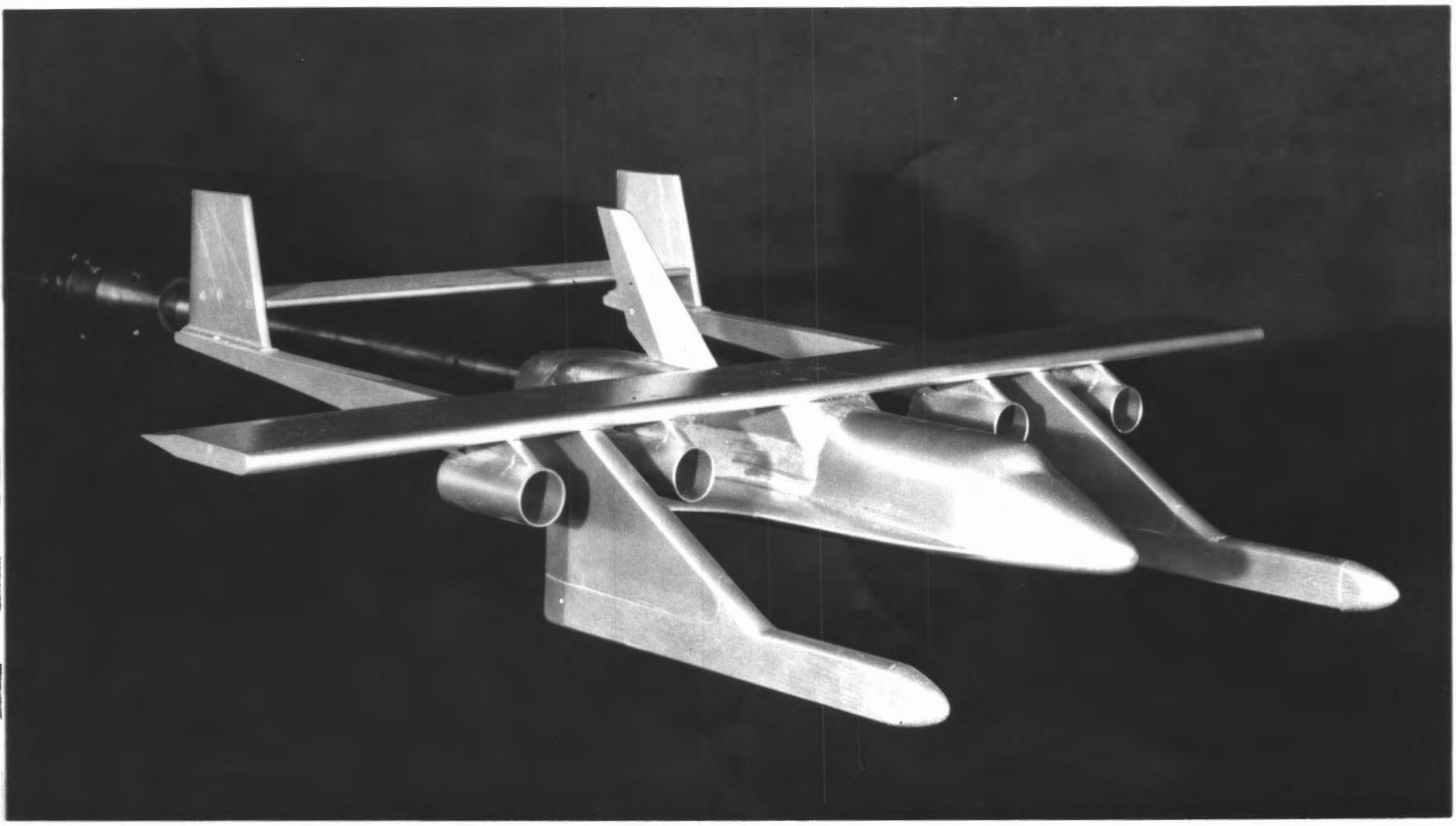
The engineering information presented here is a summary of the results of a study performed by Consulting Aerospace Engineers (C.A.E.) of Burbank, California. As mentioned in the Introduction, this manual would have been far too cumbersome had all of the calculations and data used to arrive at this summary been included. Therefore, these data and calculations are presented in an appendix to this study.

In addition to this study, we have had another outside consultant perform a brief investigation of the C.A.E. weight estimates. This study was performed without the knowledge of C.A.E. The results of this independent study confirm the weight estimates of C.A.E. and are available for inspection upon request.

There was also a brief wind tunnel study conducted by Langley Research Center. The purpose of this study was primarily to investigate possible aerodynamic interference between the Orbiter and the Virtus. No problem areas were detected in the course of this investigation and a larger tunnel model is now under construction. Results of the study using this larger model will produce much more meaningful and useful data.



NASA L-74-3195 LANGLEY RESEARCH CENTER - WIND TUNNEL MODEL



NASA L-74-3194 LANGLEY RESEARCH CENTER - WIND TUNNEL MODEL

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WESTERN REGION
P. O. BOX 92007, WORLDWAY POSTAL CENTER
LOS ANGELES, CALIFORNIA 90009

FEDERAL AVIATION ADMINISTRATION

April 2, 1974

Mr. Jack Conroy
President, Conroy Aircraft Corporation
P. O. Box F
Goleta, California 93017

Dear Mr. Conroy:

The purpose of this letter is to define the meeting that was held on February 21, 1974 relative to the proposed VIRTUS airplane program. The subject meeting was attended by Mr. Jack Conroy, accompanied by Mr. A. M. Kaplan, members of my staff, my assistant and me. The members of my staff who attended were the program branch chiefs from the Airframe, Systems & Equipment, Propulsion and Flight Test areas, as well as my staff coordinator for technical assistance.

We appreciated the opportunity to review the VIRTUS program and discussed FAA participation to assist in making engineering findings relative to the applicable Federal Aviation Regulations. We stated at that time that it would seem appropriate that this Division would provide such assistance as would be necessary in the same manner as was previously done in the "Super Guppy" program. That is to say that we would not necessarily work towards an objective of certification, but we would make findings in that regard. This participation would be predicated on NASA, through our Washington Headquarters, providing the appropriate request for this assistance.

We would be pleased to discuss this matter with you further at your convenience.

Sincerely,

R. S. Sliff

R. S. SLIFF
Chief, Aircraft Engineering Division

CONSULTING AEROSPACE ENGINEERS, INC.
3515 Pacific Avenue • Burbank, California 91505
(213) 849-2378

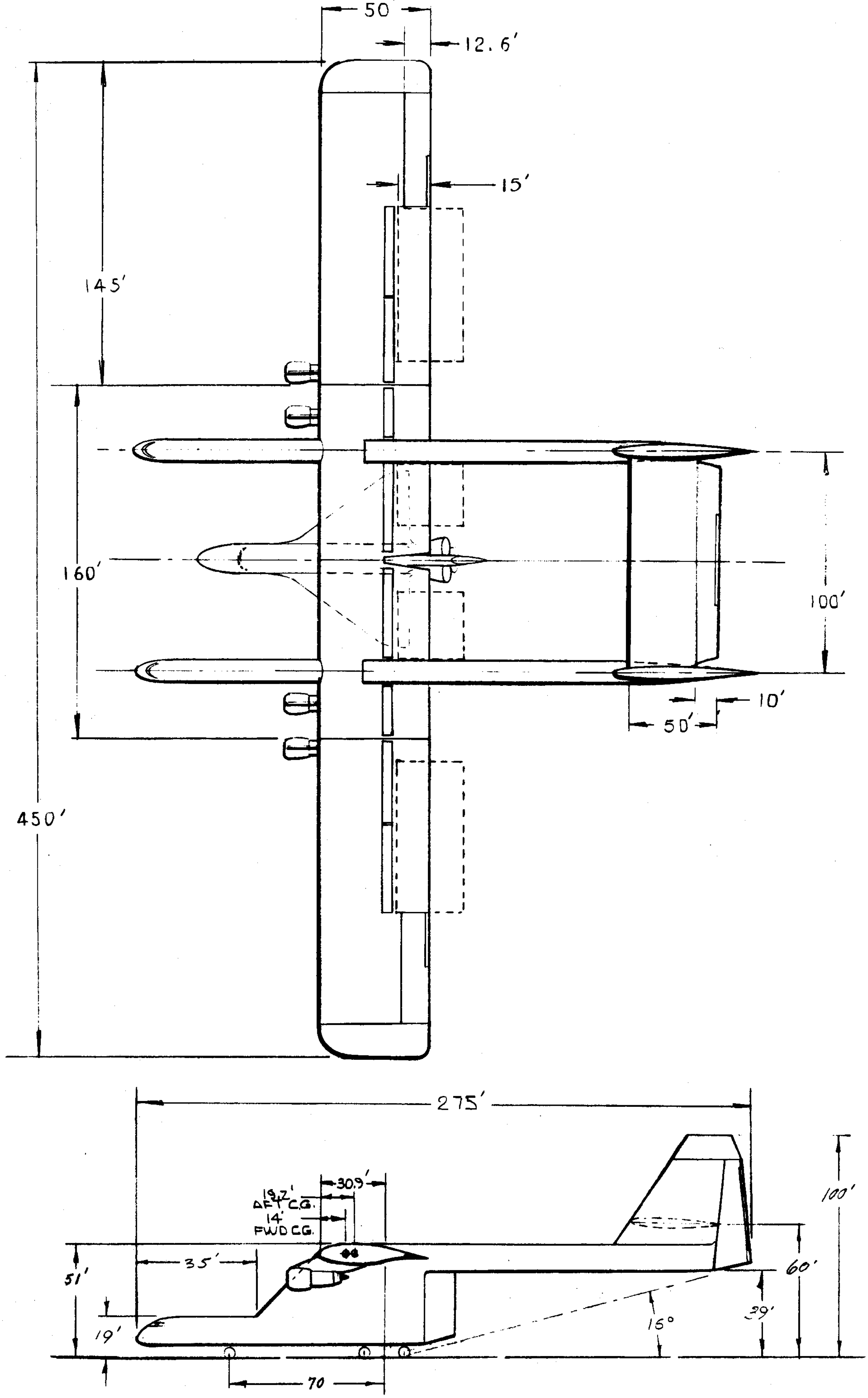
SUMMARY

VIRTUS ENGINEERING STUDY

PREPARED BY: CAE Engineering Staff.

APPROVED BY N F Pedersen DATE: 4-12-74
for M. A. Kaplan

CONTENTS


50'
12.6'
15'
145'
160'
450'
100'
10'
50'
275'
30.9'
19.2'
AFT C.G.
14'
FWD C.G.
35'
51'
19'
70
100'
60'
39'
16°

INTRODUCTION

Engineering calculations, detailed analysis and other supporting data for the Virtus Study are found in Consulting Aerospace Engineers, Report No. TT-2. Addendum to Feasibility Study Virtus, dated April, 1974. The summary presented here is a condensation of the above TT-2 Report with emphasis on the salient features and objectives of the Virtus design.

The TT-2 Report confirms the feasibility of the Virtus airplane as an air launch and air transportation vehicle for the NASA Space Shuttle Orbiter. The Virtus is a special purpose air vehicle designed to transport the Orbiter and other Shuttle major assemblies as required. It is a dual fuselage, twin boom and twin vertical tail configured aircraft. The payload is carried externally below the wing between the two fuselages. The fuselages are modified B52 airframes joined by slab-sided pylons to a zero sweep, zero dihedral, constant section wing with a 450 foot span. Referance should be made to the basic drawings listed on Page for further configuration information.

The Virtus Aircraft will cruise at a maximum of 300 MPH (261 kts) have a ceiling of 35,000 ft. and a maximum range of 3,000 miles. The maximum payload is 375,000 lbs. (475,000 lbs, useful), with a maximum gross take-off weight of 850,000 lbs. The four power plants are JT9D-3A (Pratt and Whitney) developing a total thrust (derated) of 160,000 lbs. Other new generation large fan jet engines will also be considered in the final selection.

A AIRCRAFT DESIGN ENGINEERING

The Virtus aircraft design was configured in accordance with the design criteria presented on the following pages of this section and is reflected in the engineering drawings listed on the next page. These design criteria are compatible with a performance envelope that satisfies the mission spectrum and concurs with minimum program costs, materials availability, produceability and other influencing factors.

Materials and hardware selection, systems applications and manufacturing requirements are in keeping with FAA regulations, MIL specifications and good commercial practices.

DRAWING LIST

TITLE	DRAWING NO.
1. GENERAL ARRANGEMENT Three View VIRTUS NASA	TT61160 Sheet 2
2. WING ASSEMBLY	Sheet 2
3. VERTICAL & HORIZONTAL STABILIZER ASSEMBLY	Sheet 3
4. PYLON, BOOM AND FUSELAGE ASSEMBLY	Sheet 4
5. SIDE VIEW STRUCTURAL ASSEMBLY	Sheet 5
6. MANUFACTURING BREAKDOWN OR MAJOR COMPONENTS	TT61161 Sheet 1
7. STRUCTURAL ARRANGEMENTS	Sheet 2

NOTE: The above list of drawings are not included in this summary but are for reference only and will be found in the CAE REPORT TT-2 Appendix.

Mission Criteria

The basic mission criteria of the Virtus aircraft is to serve as an air launch and transportation system for the NASA Space Shuttle Orbiter and as a transportation air vehicle for any other designated sub-system of the Shuttle Program.

Configuration Criteria

Dimensions, external

length overall	275 ft.
height overall	100 ft.
wing span	450 ft.
wing chord	50 ft.
aspect ratio	9 to 1

Areas

Wing	22,300 ft.^{2}
Flaps	2,595 ft.^{2}
Horizontal Stabilizer	4,640 ft.^{2}
Vertical Stabilizers	5,408 ft.^{2}

Weights

Empty	375,000 lbs.
Maximum Payload	375,000 lbs.
Maximum Take-off	850,000 lbs.

Wing Airfoil — NASA (GA (W)-1; .3C Fowler Flap

Landing Gear

Retractable B-52 24 wheel (12 dual wheels)
Nose wheel steerable, cross-wind correctable

	NAME	DATE	Consulting Aerospace Engineers, Inc.	PAGE
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CHECKED			TITLE III ENGINEERING STUDY	MODEL VIRTUS
APPROVED				REP. TT-2

Performance Criteria

Power Plant

4 Pratt & Whitney JT9D-3A turbo fan engines
or any of the new generation large fan engines

Take-off (derated) total thrust	160,000 lbs.
Service ceiling-Orbiter	
Launch mission	35,000 ft.
Cruising speed @ 35,000 ft.	276 mph 175 240 knots
Maximum range-Orbiter payload with 2 hours reserve	2,800 miles
Gross weight take-off distance (over a 50 ft. obstacle)	6,400 ft.
Maximum cruise speed	300 mph (260 knots)
Maximum range	3,000 miles

A AIRCRAFT DESIGN ENGINEERING

Miscellaneous Systems

All miscellaneous mechanical, electrical, hydraulic, etc. systems will be conventional in concept and hardware selection. This is obviously so for economic and operational advantages.

Actuators, pumps, motors, valves, etc. will be shelf items wherever possible. Attempts will be made to extract complete systems wherever feasible from existing airplanes in order to achieve optimum economy and maintainability.

The following systems will be among those provided in the manner indicated above:

- 400V AC & 28V DC Electrical Power
- 3000 PSI hydraulic supply
- Pressurization & air conditioning
- Engine self start
- Flight instrumentation
- Fuel management
- Defog and anti ice
- Auxiliary power unit
- Avionics
- Others.

B AIRCRAFT STRESS ANALYSIS

The stress analysis of the Virtus airframe was performed in accordance with FAR VOL. III, Part 25. Using loads derived in this manner,analyses were run on all major components and joints of the airframe. Positive margins were obtained in all cases.

The following paragraphs in this section discuss some of the details of the various major assembly and joint analyses. Allowable stresses and other material properties are per MIL Handbook 5B. Detail analysis methods are per the CAE stress memos and the established aerospace texts such as Bruhn, Roarke, Timoshenko, etc.

All primary structure in the Virtus airframe is designed Fail-Safe. Generally, this requirement is satisfied by the existence of alternate load paths. As an example, if a spar cap should fail in the wing or empennage, the remaining continuous structure in the box must be capable of carrying limit load without the aid of the failed cap. All primary structure was analyzed in this manner and positive margins were achieved for the fail-safe condition.

Basic Loads

The wing loads are computed by the method prescribed in FAR 25.337 (b). The loading is trapozoidal over the 450 ft. span. Three conditions were investigated namely, up bending at maximum gross weight, up bending at zero fuel weight and down bending in landing.

B Airplane Stress Analysis

Basic Loads (continued)

The tail loads were arrived at as extrapolations from the Super Guppy tail loads. The rationale being that the Virtus is near similar in speed, size, weight and maneuverability.

Wing

The wing is analyzed as a typical skin stringer construction with three spar. The spar caps are milled 7075-T6 aluminum alloy. The webs are stiffened with riveted on stiffeners. The wing ribs are trussed with extruded chord members and cruciform extruded diagonals. All wing material is 7075-T6. The wing stringers are formed hat sections. The skins vary uniformly in thickness to optimize weight reduction. All fuel is carried in the outer wings for inertia relief. Ribs are spaced 4 ft. on center at the root and 8 ft. at the tip. Stringers are 10 in. on center. Spars are 150 inches on center. The skins at the root are .250 inches thick and taper to .032 7075-T6 aluminum clad sheet at the tip.

Empennage

The general mode of construction of the empennage is similar to the wing. The material is all 7075-T6 Aluminum Alloy.

B Aircraft Stress Analysis

Empennage (continued)

The vertical stabilizer box structure is a three spar arrangement with each spar tied in tension to bathtub fittings which shear tie to frames in the boom. Ribs are spaced 3 feet on center and stringers 10 inches apart for both the horizontal and vertical stabilizer.

The vertical box is analyzed as a beam column combining air load, horizontal surface end moments (with partial fixity) and the vertical loads. The horizontal stabilizer spars are 150 inches apart and mate with the vertical stabilizer beams through machined fittings.

Fuselage and Pylon

The twin fuselages are B52 airframes modified to adapt to the twin pylons and to contain three B52 main landing gear assemblies each. The forward 100 ft. of the fuselage is nearly identical in structural configuration to the existing B52 airframe

The two fuselage pylons contain three main vertical beams each, coplanar respectively with the three wing spars. The pylon beam caps extend up through the wing lower surface to form a shear tie with each respective wing spar for the full wing depth. The pylon transfers loads from the fuselage and boom to

B Aircraft Stress Analysis

Fuselage and Pylon (continued)

the wing. Hat section stringers spaced 10 inches on center run fore and aft throughout the pylon structure and are riveted to the skin panels. Intermediate frames are used to optimize panel size. Panels have been analyzed as shear resistant in areas of high shear transfer and as tension field in the lower pylon region. Pylon skin thickness will vary from .250 inches at the wing attach area down to .051 7075-T6 aluminum clad sheet in the lower region at the fuselage attach area.

Landing Gear

The main landing gear arrangements for each fuselage will be similar to the B52 configuration with one exception that being the addition of a third identical gear aft of the second main gear. Thus each fuselage will have three identical main landing gears in line as shown on Drawing No. TT61160 Sheet 1.

Substantiation of this arrangement will be based on confirming the critical loading on any given landing gear as being no more severe than the environment it now sees on the B52 airplane.

B Aircraft Stress Analysis (continued)

Boom

The twin booms transmit the empennage load to the wing through the upper portion of the fuselage pylon. The booms are rectangular in cross section (144 inches high by 120 inches wide) with milled longerons in each corner. Stringers are 10 inches on center and are formed hat sections. Skins vary from .188 inches to approximately .050 7075-T6 clad. Frames are spaced at seven feet on center. All material is 7075-T6 aluminum alloy.

Control Surfaces and Wing Trailing Edge

Corrugated skins are employed in portions of the control surfaces and wing trailing edge. This allows skin panels in some areas to run as low as .016 thick 7075-T6 aluminum clad sheet.

Fittings and Splices

Bathtub type machined fittings are used at most main joints in the airframe to transmit stringer and cap axial loads. Shear loads are generally taken out at major joints with large doublers.

Orbiter Adapter Attachment Structure

Twelve hardpoints are located on the wing center box lower surface to pick up the payload adapter. Each hardpoint is located at a wing beam/ main rib intersection at four main rib stations. Refer to Fig. 2 on the following page. Each hardpoint

PREPARED	NAME: NFP	DATE: 3-27-74	Consulting Aerospace Engineers, Inc.	PAGE
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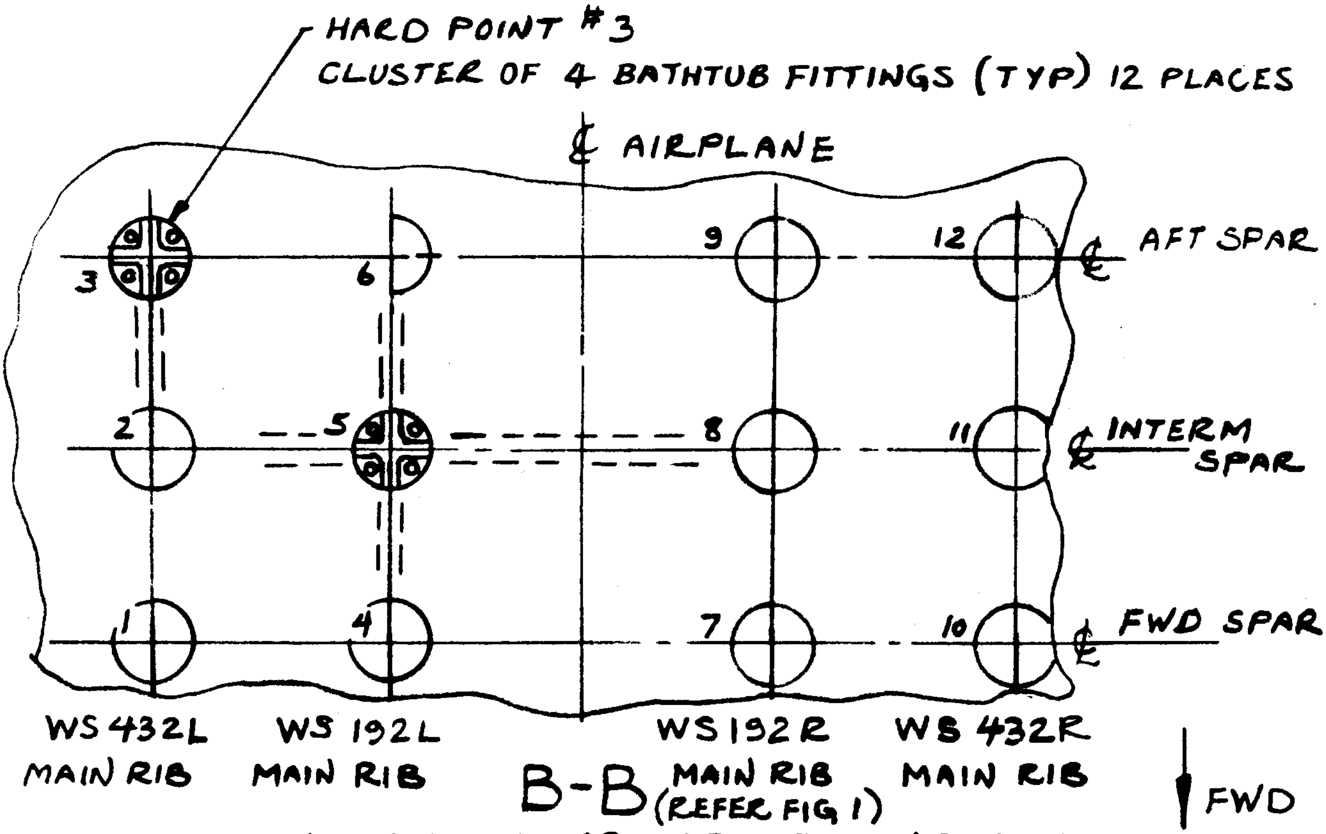
B. AIRCRAFT STRESS ANALYSIS
PAYLOAD SUPPORT GEOMETRY AND LOADS



B-B (REFER FIG 1)
VIEW LOOKING UP AT WING BOX LOWER SURFACE

ASSUMPTIONS :

1. THE FORWARD AND DOWN COMPONENTS OF THE PAYLOAD WILL BE TRANSMITTED TO THE WING CENTER BOX AT TWELVE HARD POINTS POSITIONED AS SHOWN ABOVE.

2. FORE & AFT LOADS WILL GO INTO THE MAIN RIBS AS SHEAR AND THE VERTICAL LOADS WILL GO DIRECTLY INTO THE SPARS

3. THE FITTINGS AT EACH HARD POINT WILL BE FLUSH BATHTUBS WITH TENSION BOLTS PICKING UP THE PAYLOAD ADAPTOR STRUCTURE. THE BATHTUBS WILL ATTACH DIRECTLY TO THE BEAMS AND MAIN RIBS WITH SHEAR TIES (4 FITTINGS/HARD PT)

B Aircraft Stress Analysis

Orbiter Adapter Attachment Structure (continued)

has a cluster of four bathtub fittings and barrel nuts to receive the tension bolts that tie the adapter to the wing. Bending loads go directly into the spars and fore and aft shear is taken by the four main ribs.

Miscellaneous Equipment Required to Carry Orbiter

We are assuming that the design and manufacturing of this equipment will be the responsibility of NASA and/or the prime contractor of the Orbiter Program. However, we would provide interfacing engineering coordination.

Generally, this equipment consists of a system that secures the Orbiter in flight and provides for in-flight release. Various concepts are being evaluated at this time. They include electro-mechanical,hydro-mechanical and explosive schemes.

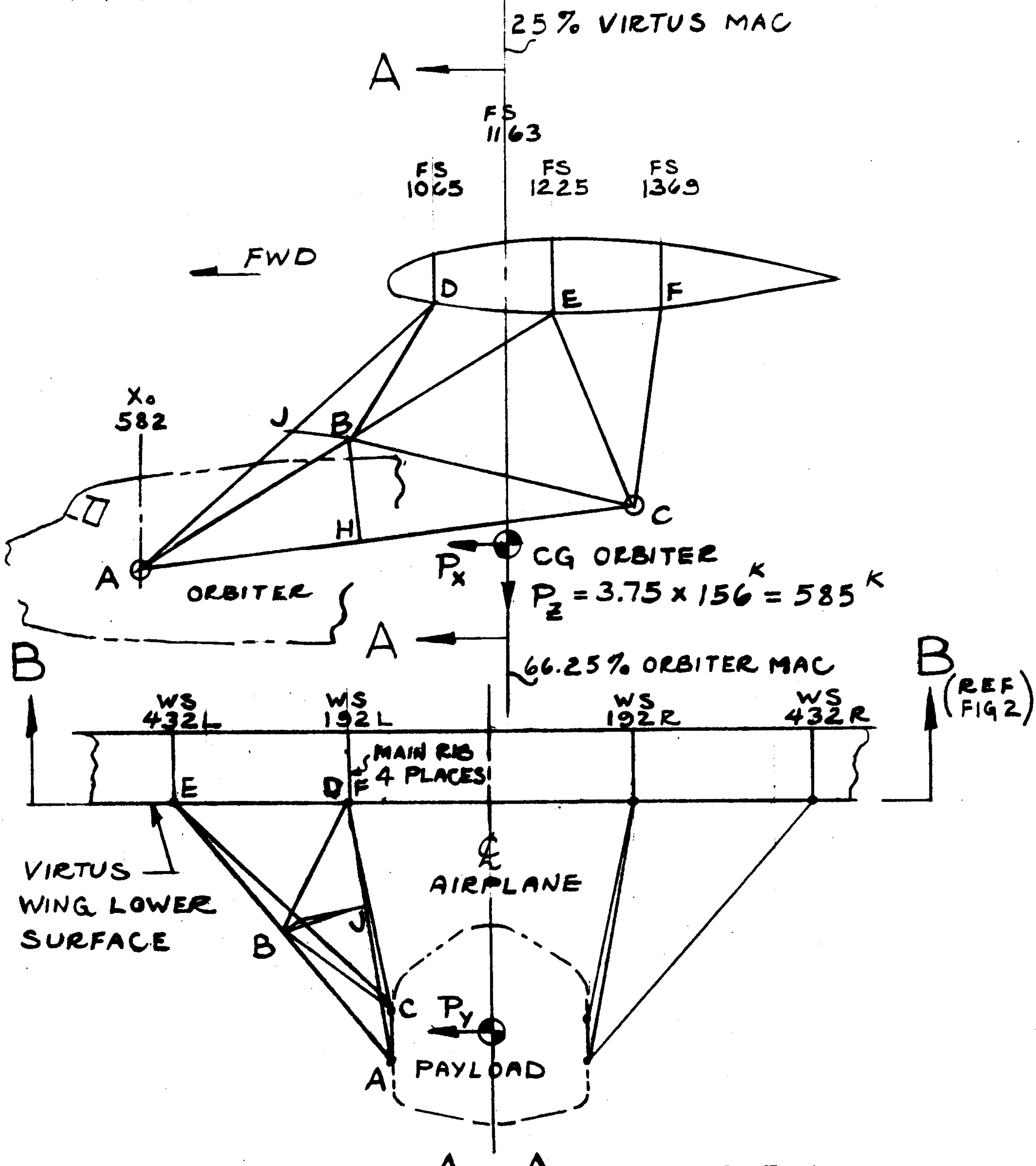
In determining the optimum approach, consideration should be given to reliability, maintainability, simplicity, cost and other trade-offs. The system must be capable of loading and unloading the Orbiter on the airstrip in a single and expeditious manner. Cockpit monitoring would be a part of the system including warning lights. The locking mechanism must be positive and fail safe. Monitoring provisions must also route to the Orbiter flight station. Fig. 1, Page shows a schematic of a truss type arrangement for Orbiter suspension.

PREPARED	NAME: N F P	DATE: 3-27-74	Consulting Aerospace Engineers, Inc.	PAGE
CHECKED			TITLE: III ENGINEERING STUDY FIGURE 1	MODEL: VIRTUS
APPROVED				REF. T T 2

B. AIRCRAFT STRESS ANALYSIS

PAYLOAD SUPPORT GEOMETRY AND LOADS

A SPACE TRUSS AS SHOWN BELOW WILL BE USED AS AN APPROXIMATION OF THE ADAPTOR CONFIGURATION FOR PURPOSES OF ANALYSIS.



A - A LOOKING FWD

C. AERODYNAMICS, PERFORMANCE AND SPECIFICATION ANALYSIS

The aerodynamic characteristics of the Virtus airplane are the results of a compromise with manufacturing cost, produceability, aerodynamic cleanliness and state-of-art technology within a given performance envelope.

The Virtus is a high wing, very large special purpose airplane with performance characteristics in the C5A and Super Guppy regime. It is a twin fuselage, twin boom and twin vertical tail configured airplane. The payload is externally supported below the center wing between the fuselages.

Proper consideration was given to aerodynamic cleanliness. Fillets are employed at external surface intersections. The surfaces are liberally faired where required. Flush riveting is employed throughout the external surfaces and the leading edges of all external doublers are feathered. The large payload adapter truss members will be aerodynamically faired as required to minimize parasitic drag.

The wing employs a NASA GA(W)-1 constant section airfoil. It has zero sweep, zero twist, a 450 ft. span and a 50 ft. chord with an aspect ratio of 9:1. The wing includes a partial span 30% Fowler flap. Spoilers span over 270 ft. of the wing and are used in conjunction with the aileron to optimise roll control effectivity and to provide glide slope control. The wing is placed high for good lift distribution and to facilitate good stall characteristics. Special attention was given to the wing tip design to maximize the sub sonic efficiency of the 9:1 aspect ratio wing. The engines are located in a manner that places the air intake outside of the boundary layer of the wing.

C. Aerodynamics, Performance and Specification Analysis (continued)

The twin vertical tail was selected to accomodate the twin fuselage concept with an optimum structural interface. The efficiency of the horizontal tail is increased due to the end plate effects of the twin verticals. This reduces the horizontal tail area requirement. Highly located booms support the empennage in a position that lends itself to efficient tail surface control. The fuselage configuration provides structural carry through for the booms and employs readily available airframe sections and equipment.

The performance envelope for the Virtus airplane provides the various capabilities described below:

> At the gross weight condition (850,000 lbs) the maximum true airspeed is 276 mph (240 kts) and the maximum rate of climb is 1100 fpm.

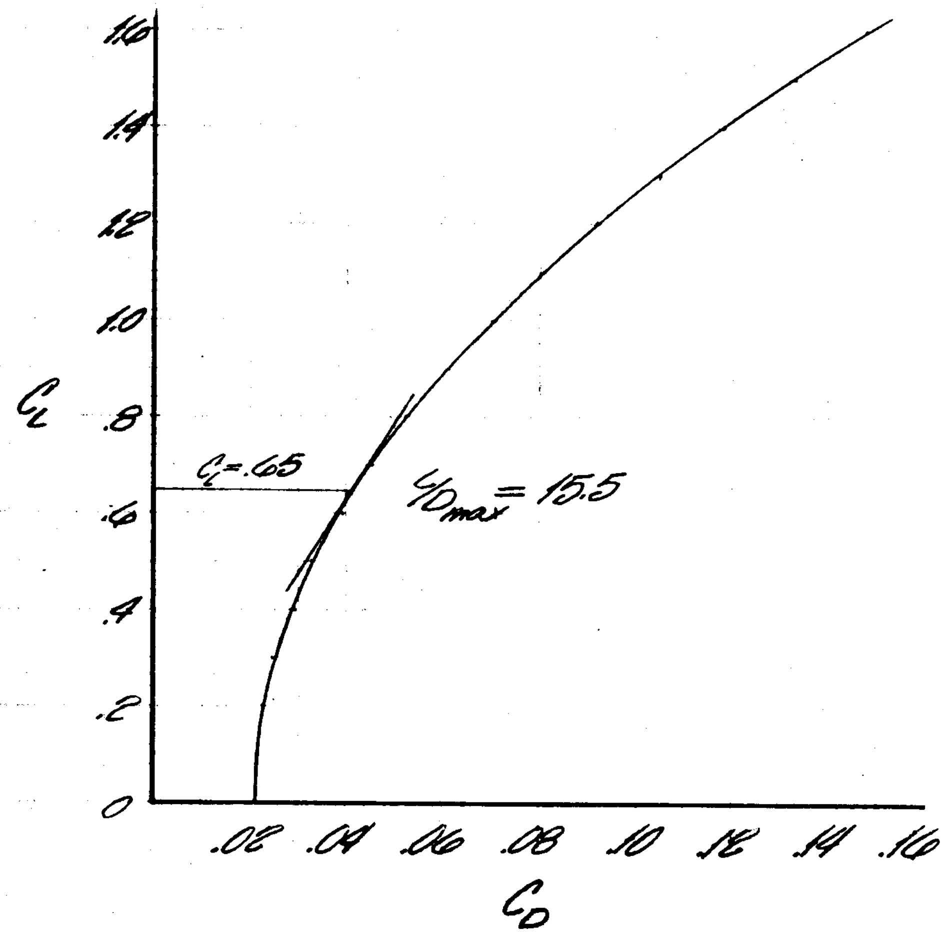
With the four Pratt and Whitney JT9D turbo fan engines providing 160,000 lb. thrust (derated) it is estimated that the Virtus can take off in 5900 ft. and clear an obstacle of 50 ft. This is at sea level on a standard day with a maximum gross of 800,000 lb.

The service ceiling with an Orbiter payload is 35,000 ft. The cruising speed at 35,000 ft is calculated at 276 mph. (240 kts). The maximum range with an Orbiter payload and 2 hrs. fuel reserve is 2800 miles.

Representative performance curves are presented on the following three pages.

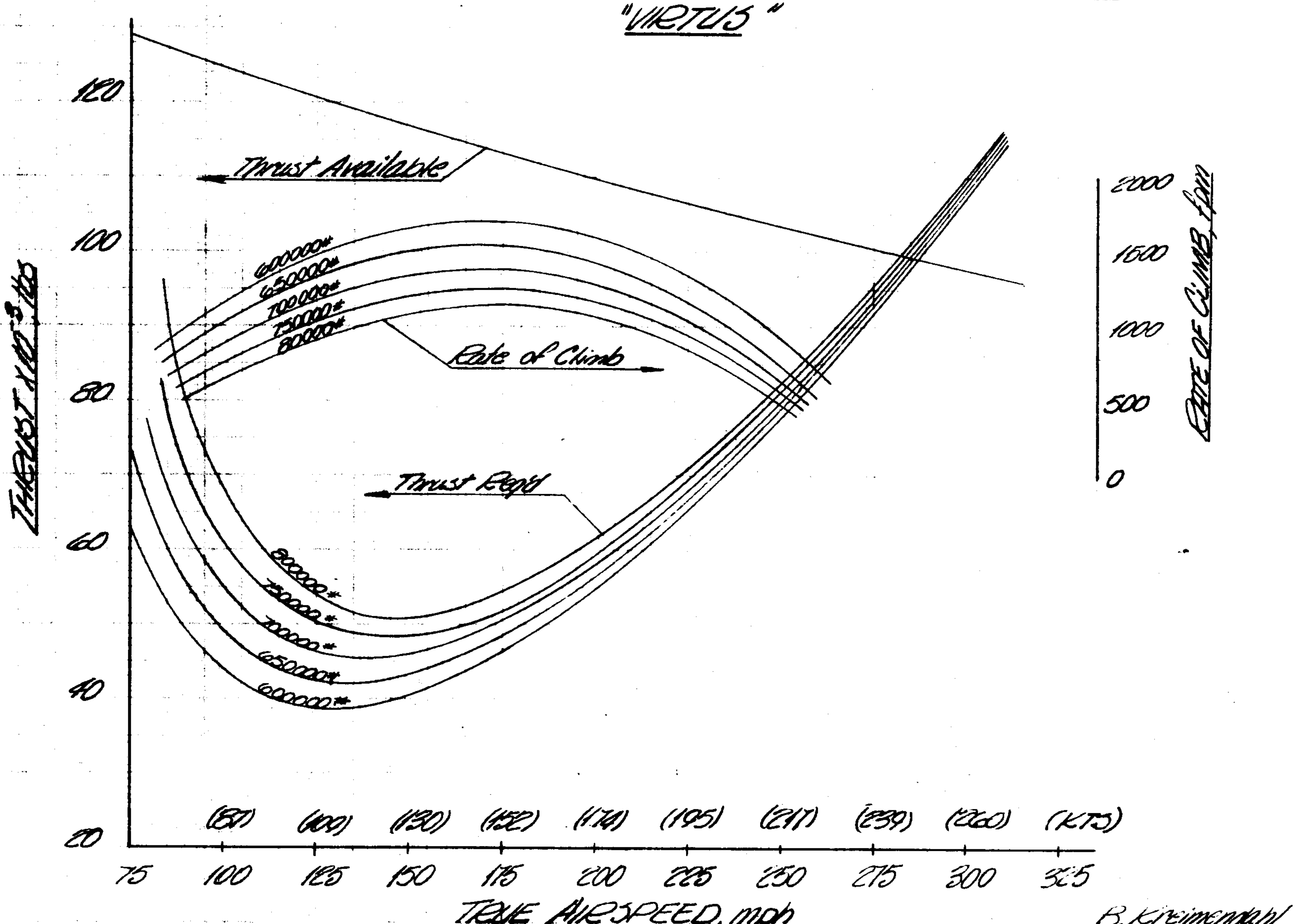
ESTIMATED DRAG POLAR OF THE "VIRTUS"

$C_D = .0210 + .0496\, C_L^2$



B. Kreimendahl
3·5·74

CALCULATED THRUST REQUIRED,^ THRUST AVAILABLE# AND RATE OF CLIMB AT SEA LEVEL - ICAO STANDARD DAY
"VIRTUS"



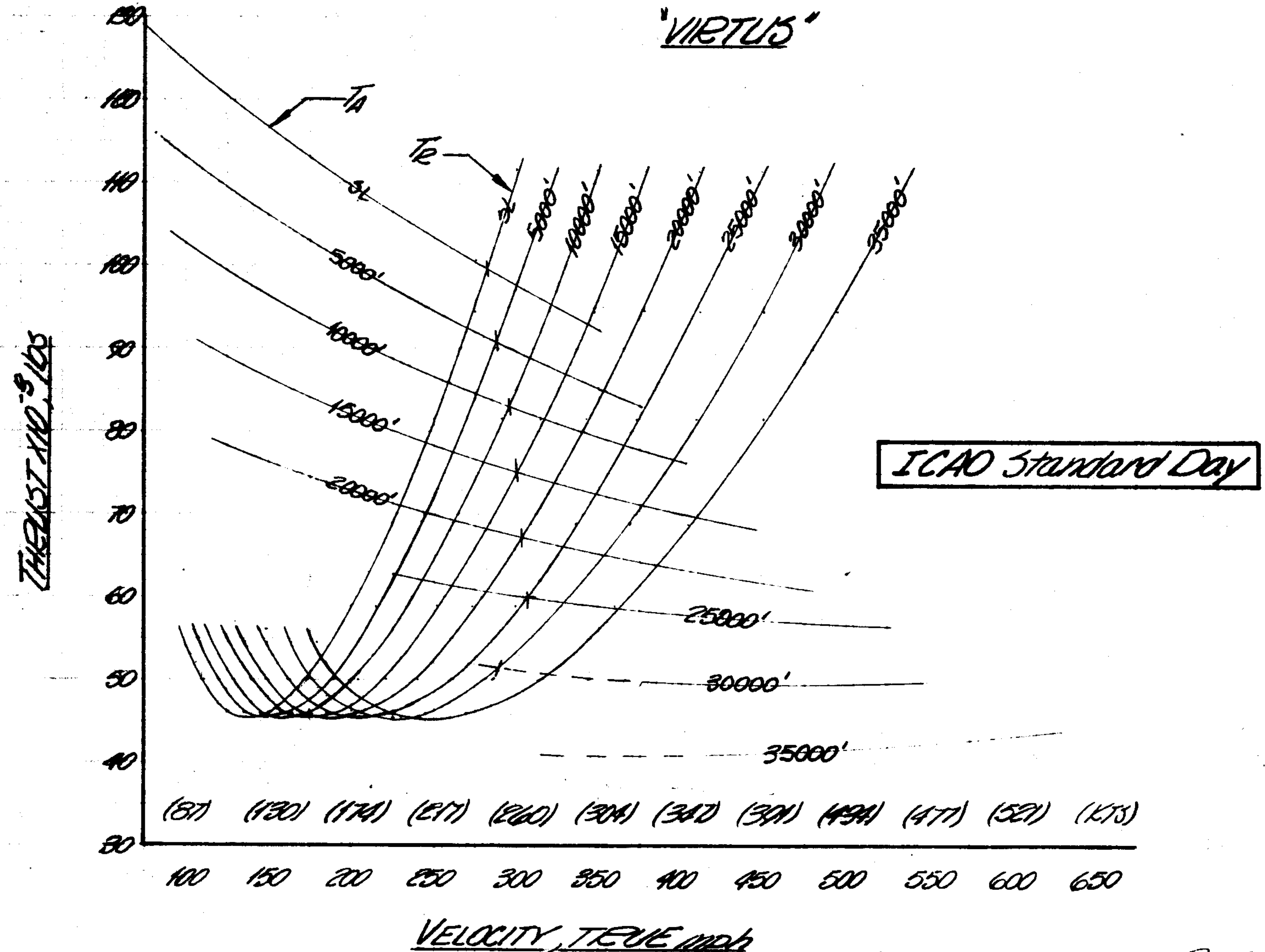
100% ram recovery
no air bleed
no power extraction

^ Orbiter attached in ferry cond.

B. Kreimendahl
3-6-74

THE VARIATION OF THRUST AVAILABLE AND THRUST REQUIRED WITH VELOCITY FOR VARIOUS ALTITUDES (W= 700,000 lbs)

"VIRTUS"



dash lines indicate extrapolation

B. Kreimendahl
3-7-74

4.0 PERFORMANCE

D STABILITY AND CONTROL ANALYSIS

Longitudinal, directional and lateral stability of the Virtus has been investigated. Control effectiveness was also studied. The longitudinal center of gravity limits are established as 34.6 to 38.7 percent mean aerodynamic chord. Further it was determined that the Orbiter payload had negligible effect on the Virtus stability.

Static directional stability (rudder fixed) was found to comply with requirements determined by Perkins & Hage. Rudder power was found to be sufficient for the critical engine out condition, with full power.

The helix angle for lateral control compared favorably with the Perkins and Hage established criteria for aircraft of equivalent requirements.

Water ballast will be employed if required to adjust C.G. limits for certain payload conditions.

E. WEIGHT ANALYSIS

The results of a preliminary weight analysis for the zero fuel condition are summarized on the following pages. Also included is a Major Assembly Weight Breakdown for manufacturing information.

E. WEIGHT ANALYSIS (CONTINUED)

WEIGHT SUMMARY AND HORIZONTAL CG. CALCULATION

ZERO FUEL CONDITION

ITEM	WEIGHT	ARM FROM WING L.E. (FEET)	MOMENT
WING			
Box	138510		
Flaps	3640		
Ailerons	1764		
Spoilers	2240		
* Systems & Misc.	9446		
	155600	17.5	2723000
HORIZONTAL TAIL			
Box	13883		
Elevator	1401		
* Systems & Misc.	507		
	15791	158	2494978
VERTICAL TAILS			
Box	11057		
Rudders	1332		
* Systems & Misc.	333		
	12722	160	2035520
FUSELAGE			
Forward Section	27920		
* Systems & Misc.	18194		
	46114	-27	-1245078
Fuselage Pylons	30394		
* Systems & Misc.	3000		
	33394	19	634486
Booms	31604		
* Systems & Misc.	3160		
	34764	86	2989704

* NOTE: Systems & Misc. includes controls, fuel & hydraulic systems & fittings

PREPARED	NAME	DATE 4/11/74	Consulting Aerospace Engineers, Inc.	PAGE
CHECKED			TITLE III ENGINEERING STUDY	MODEL VIRTUS
APPROVED				REP. TT 2

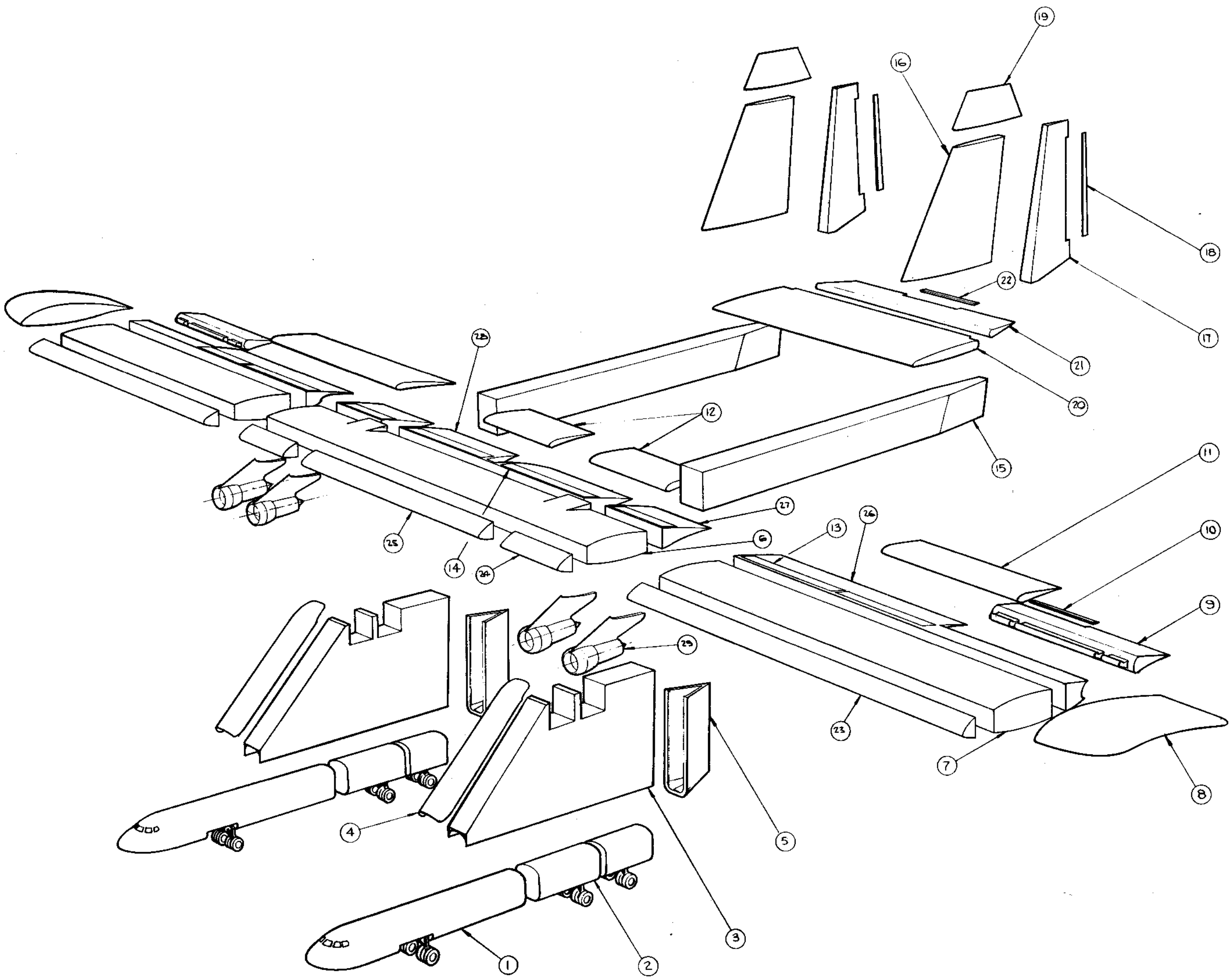
E. WEIGHT ANALYSIS (CONTINUED)

WEIGHT SUMMARY AND HORIZONTAL C.G. CALCULATION

ZERO FUEL CONDITION

ITEM	WEIGHT	ARM FROM WING L.E. (FEET)	MOMENT
Engines & Pylons	40000	-10	-400000
LANDING GEAR			
Fwd	11000	-39	-429000
Aft	22000	31	682000
Totals	371385		9485610

CG @ 25.5 ft. (517.)



29 ENGINES & PYLONS PRATT & WHITNEY JT9D-3A TURBOFAN
28 WING TRAILING EDGE CENTER SECTION
27 WING TRAILING EDGE CENTER SECTION LEFT & RIGHT HAND SIDE
26 WING TRAILING EDGE OUTBOARD PANEL LEFT & RIGHT HAND SIDE
25 WING LEADING EDGE CENTER SECTION
24 WING LEADING EDGE CENTER SECTION LEFT & RIGHT HAND SIDE
23 WING LEADING EDGE OUTBOARD PANEL LEFT & RIGHT HAND SIDE
22 ELEVATOR TRIM TAB
21 ELEVATOR
20 HORIZONTAL STABILIZER
19 VERTICAL STABILIZER TIP LEFT & RIGHT HAND SIDE
18 RUDDER TRIM TAB LEFT & RIGHT HAND SIDE
17 RUDDER LEFT & RIGHT HAND SIDE
16 VERTICAL STABILIZER LEFT & RIGHT HAND SIDE
15 BOOM LEFT & RIGHT HAND SIDE
14 WING SPOILERS CENTER SECTION LEFT & RIGHT HAND SIDE
13 WING SPOILERS OUTBOARD PANEL LEFT & RIGHT HAND SIDE
12 WING FLAPS CENTER SECTION LEFT & RIGHT HAND SIDE
11 WING FLAP OUTBOARD LEFT & RIGHT HAND SIDE
10 AILERON TRIM TAB LEFT & RIGHT HAND SIDE
9 AILERON LEFT & RIGHT HAND SIDE
8 WING TIP LEFT & RIGHT HAND SIDE
7 WING OUTBOARD PANEL LEFT & RIGHT HAND SIDE
6 WING CENTER SECTION
5 PYLON FAIRING AFT LEFT & RIGHT HAND SIDE
4 PYLON FAIRING FORWARD LEFT & RIGHT HAND SIDE
3 PYLON SUPER STRUCTURE LEFT & RIGHT HAND SIDE
2 B-52 LANDING GEAR SECTION MODIFIED LEFT & RIGHT HAND SIDE
1 B-52 FWD FUSELAGE MODIFIED LEFT & RIGHT HAND SIDE

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CHECKED			TITLE 10.0 WEIGHTS	MODEL VIRTUS
APPROVED				REF. TT2

10.1.1 MAJOR ASSEMBLY WEIGHT BREAKDOWN

A	WT K-LB PER UNIT	UNITS PER A/C	WT (K-LBS) PER A/C	DESCRIPTION
1	23.3	2	(1) 46.6	FWD FUSELAGE B52 MOD
2	7.8	4	(2) 31.2	LANDING GEAR B52 MOD
3	16.7	2	(2)(3) 33.4	PYLON SUPER STRUCT
4	.7	2	1.4	PYLON FWD FAIRING
5	1.2	2	2.4	PYLON AFT FAIRING
6	44.7	1	(2) 44.7	WING CENTER SECTION
7	39.0	2	(2) 78.0	WING OUTBD PANEL
8	2.5	2	5.	WING TIP
9	.88	2	1.76	AILERON
10	.10	2	.2	AILERON TRIM TAB
11	1.2	2	2.4	WING FLAP OUTBD
12	.6	2	1.2	WING FLAP CENTER
13	.3	4	1.2	WING SPOILERS OUTBD
14	{.2 .3	2 2	1.0	WING SPOILERS CENTER
15	17.4	2	(2) 34.8	BOOM
16	4.58	2	(2) 9.16	VERT STABILIZER
17	.9	2	1.8	RUDDER
18	.1	2	.2	RUDDER TRIM TAB
19	.25	2	.5	VERT STABILIZER TIP
20	15.0	1	(2) 15.0	HORIZ STABILIZER
21	1.01	1	1.01	ELEVATOR
22	.15	1	.15	ELEVATOR TRIM TAB
23	.7	2	1.4	WING L.E. OUTBD
24	.4	2	.8	WING L.E. CENTER LH, RH
25	.8	1	.8	WING L.E CENTER
26	1.3	2	2.6	WING T.E. OUTBD
27	.8	2	1.6	WING T.E. CENTER LH, RH
28	1.6	1	1.6	WING T.E CENTER SECTION
29	10.	4	(2) 40.	ENGINES & PYLONS

(A) ITEM NO. AS IT APPEARS ON CAE DWG NO. TT61161 SHEET 1 (MFG BREAKDOWN)

(1) INCLUDES FURNISHINGS, SYSTEMS, EQUIPMENT AND CONTROLS

(2) INCLUDES SYSTEMS & CONTROLS (3) INCLUDES EQUIPMENT

F CONTROL SYSTEM

The Bertea Corporation, Irvine, California, performed a preliminary study of the Virtus Flight Control System requirements. The results of this study are presented on the following pages.

BERTEA

18001 VON KARMAN AVENUE, IRVINE, CALIF. 92664 · PHONE (714) 833-1424

28 March 1974
MMKD:3281

Turbo Three Corporation
P. O. Box F
Goleta, California 93017

Attention: Mr. J. M. Conroy, President

Subject: NASA Space Shuttle Orbiter Transporter Development Program - Virtus Aircraft

Reference:
(1) Mr. J. M. Conroy - Turbo Three Corporation, Santa Barbara, California
(2) Mr. A. M. Kaplan - Consulting Aerospace Engineers, Inc., Burbank, California
(3) Bertea Quote No. 3-13-N4

Gentlemen:

In confirmation of our mutually expressed interest, should the Turbo Three Corporation receive a NASA contract for the manufacture of the aircraft required for the subject Orbiter Transporter Program, the Bertea Corporation herein offers its technical and manufacturing services as the preselected subcontractor for the design, development and supply of all of the electrohydraulic powered flight control equipment requirements that will be proposed to this subject aircraft program.

In addition, we would assist CAE in the selection of an autopilot manufacturer and work with this supplier in establishing the necessary interface requirements between our two subsystems.

We would further offer our assistance in either the supply or selection of the additional utility hydraulic components, modules and actuators that will be a part of the aircraft's various systems and subsystems.

We will assure your organization that your program will be totally supported with all the assistance and talents at the disposal of Bertea Corporation to insure the success of your aircraft program objectives.

Should the intent of our proposed offer meet with your understanding and approval, we should like the opportunity to further discuss a mutual agreement that will define the required scope of work and to negotiate the necessary dollars to accomplish the task.

We wish you success in the outcome of your feasibility study proposal to NASA and will look forward to working with your company in the development of the Virtus Airplane.

Sincerely,

BERTEA CORPORATION

Don E. Williams

D. E. Williams
Marketing

BERTEA CORPORATION
IRVINE • CALIFORNIA

FLIGHT CONTROL ACTUATION SYSTEM FOR ORBITER TRANSPORT AIRCRAFT

Two basic concepts are provided for consideration for the subject flight control actuation system.

An actuator schematic and system schematic are attached for a fly-by-wire flight control actuation system. This system, in order to be fail operative would require a minimum of two active actuation channels per axis and an electronic failure detection and correction "black box". The purpose of the failure detection and correction system would be to monitor the "inflight" performance status of the active channels and to compare them with a passive electronic analog channel. In the event of a failure of either of the two active channels, annunciation would be provided to the flight in the form of warning lights. The action of the flight crew would be to shut down the failed channel. In the case of the horizontal control axis, four active channels would be available and the system would be fail operation - fail operational - fail safe. Since a failure in the aileron or rudder control axes would not necessarily be flight critical, the proposed fly-by-wire concept could be considered certifiable.

In the event that the fly-by-wire system were not acceptable, a conventional hydromechanical powered flight control system is shown in the second attachment. This system uses an electrical pilot assist servo in each axis with a conventional mechanical cable and push rod backup. The pilot assist servo could be either single or dual channel and would be a relatively simple electrohydraulic position servo system that would function as a parallel actuator in conjunction with the feel and centering springs for each axis. These servos could also function as the autopilot servo actuators. In the event of failure of the pilot assist servos, they could be deactivated and the surface control actuators could be operated through the cable system. The flight control surface actuators shown schematically in the attachment are conventional dual tandem hydromechanical position servos and are typical of the actuation systems used on all current military and commercial flight controls.

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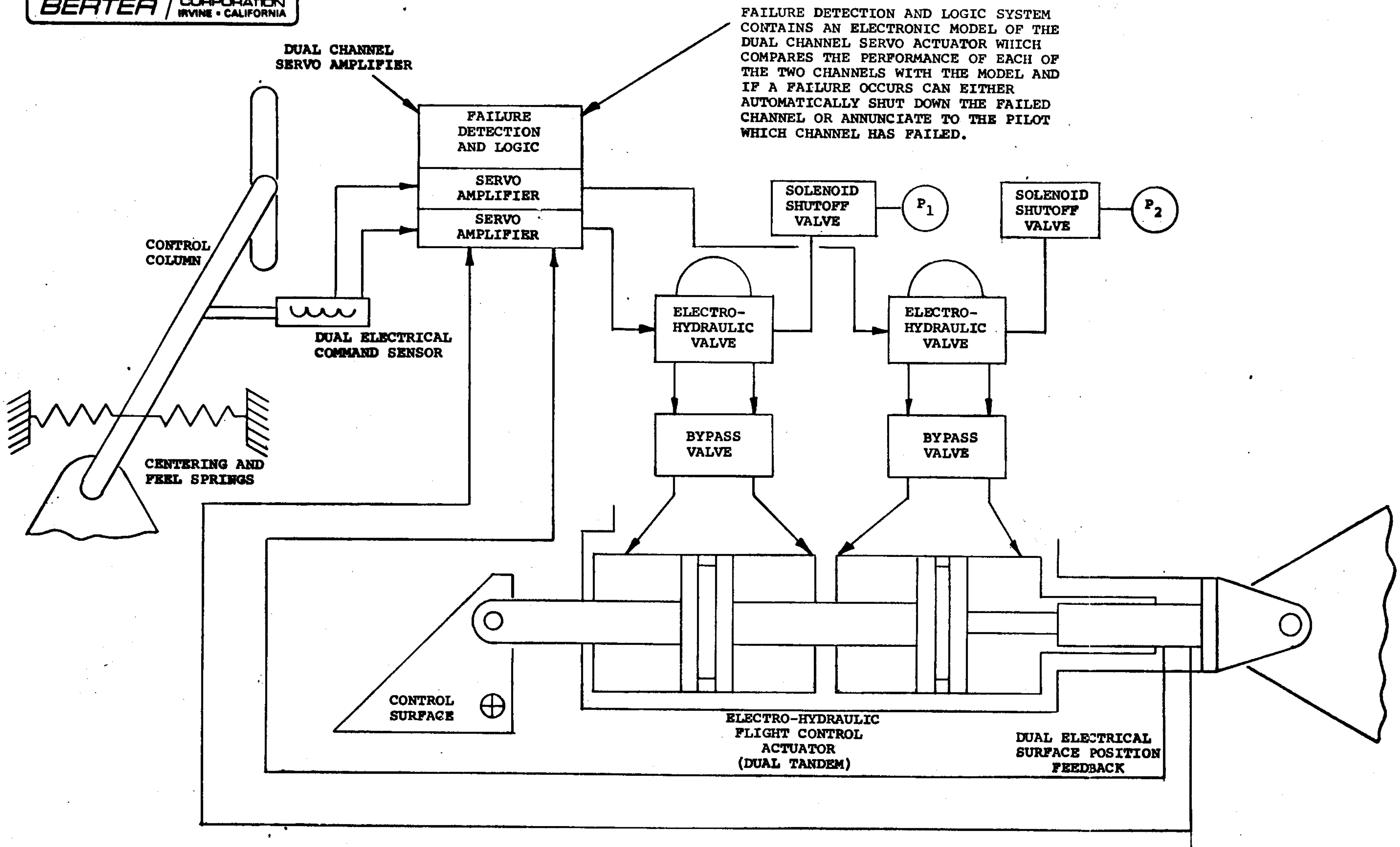
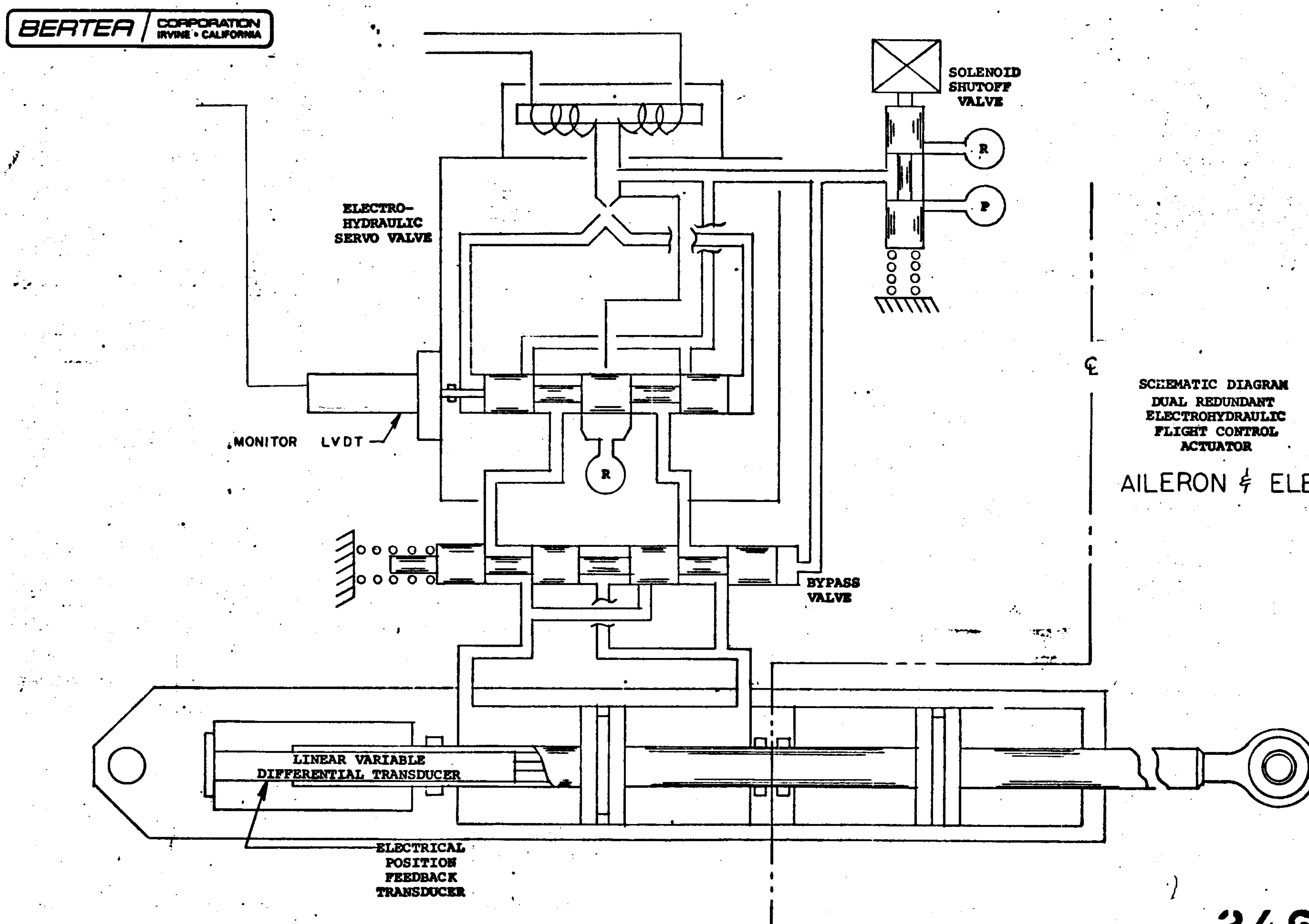


DUAL REDUNDANT
SCHEMATIC DIAGRAM

FLY-BY-WIRE FLIGHT CONTROL
ACTUATION SYSTEM
AILERON & ELEVATOR

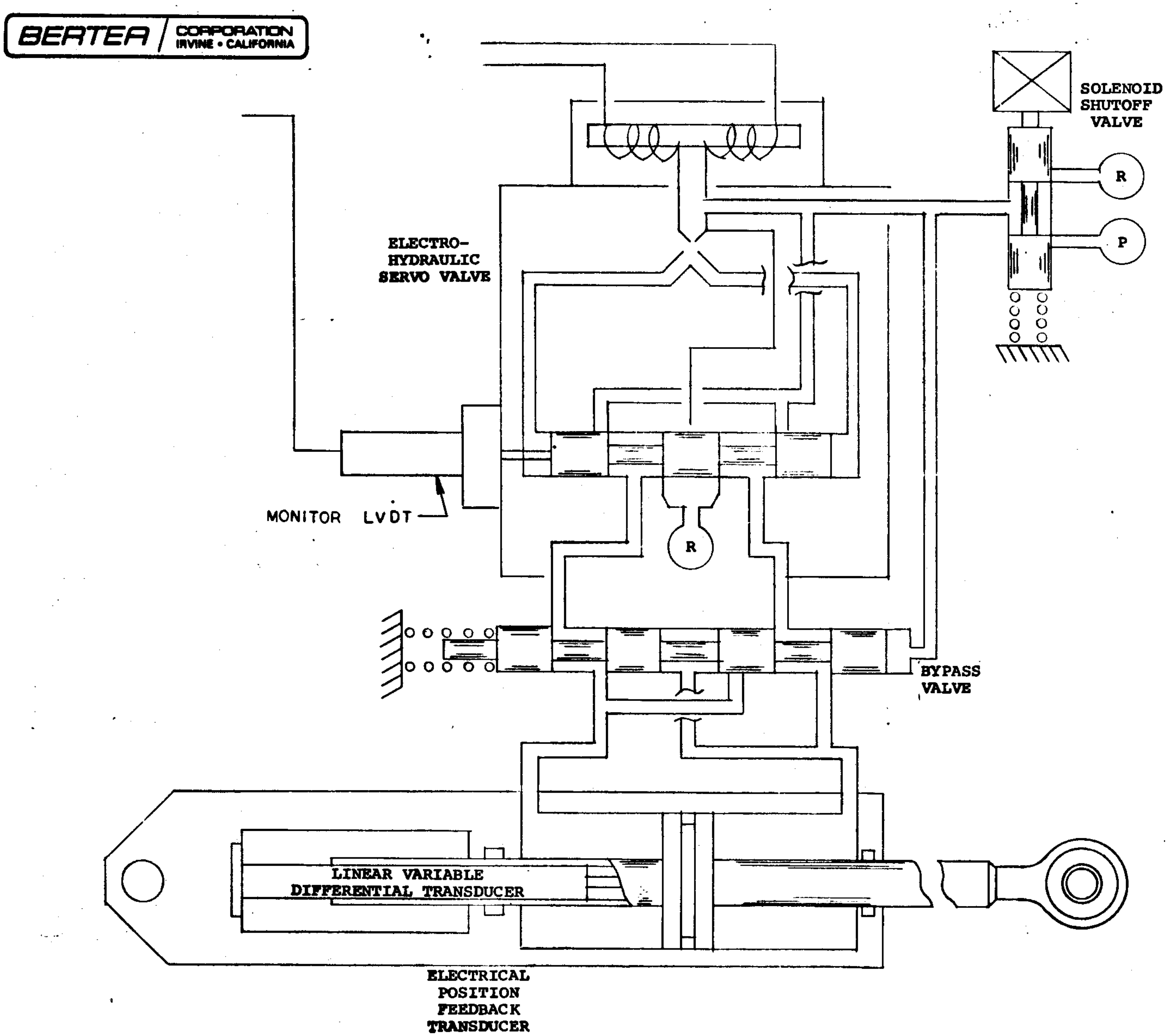
246000



SCHEMATIC DIAGRAM
DUAL REDUNDANT
ELECTROHYDRAULIC
FLIGHT CONTROL
ACTUATOR

AILERON & ELEVATOR

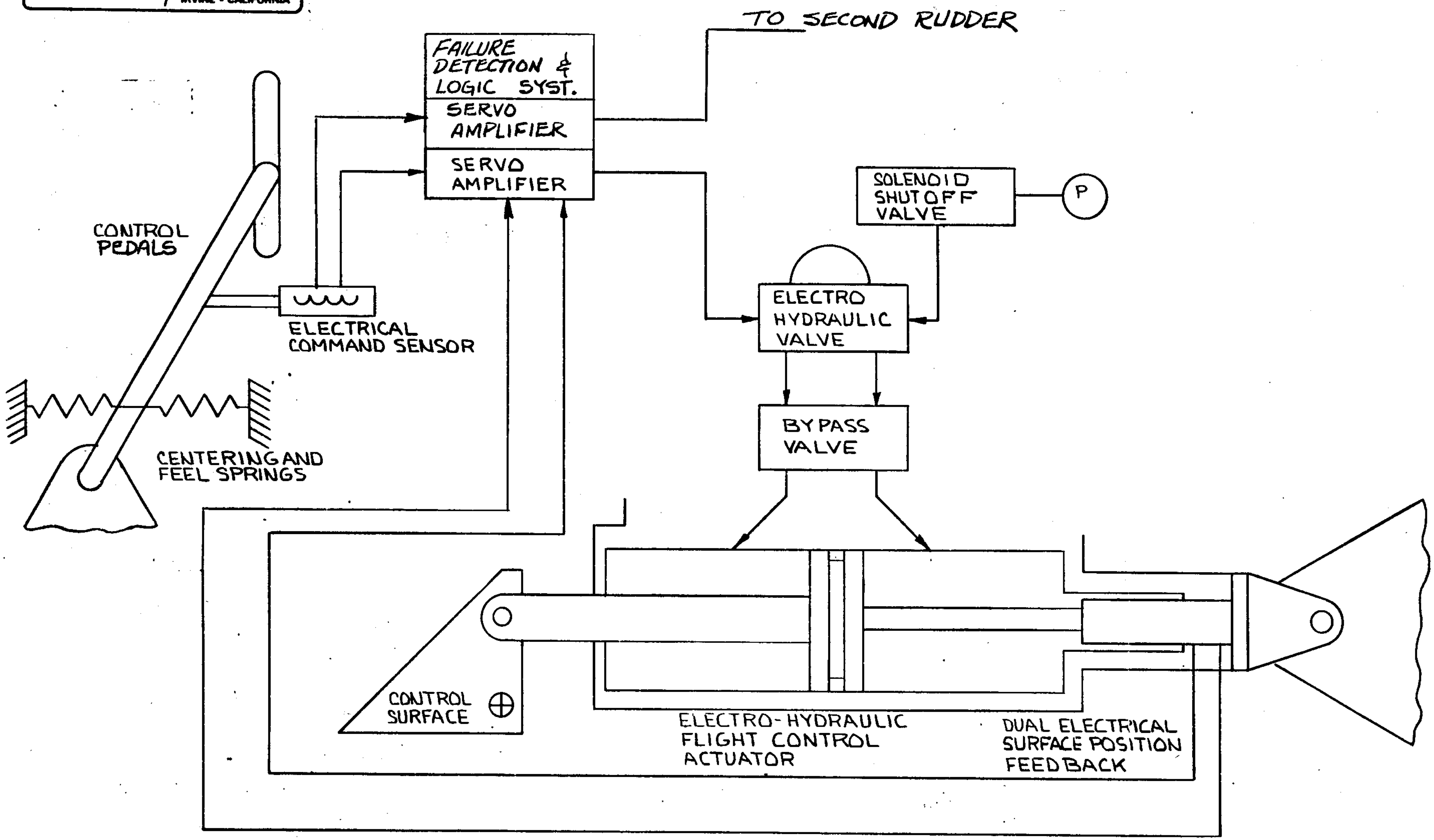
246000



SCHEMATIC DIAGRAM

ELECTROHYDRAULIC
FLIGHT CONTROL
ACTUATOR

RUDDER



SCHEMATIC DIAGRAM
FLY BY WIRE FLIGHT CONTROL
ACTUATOR SYSTEM
RUDDER

246000

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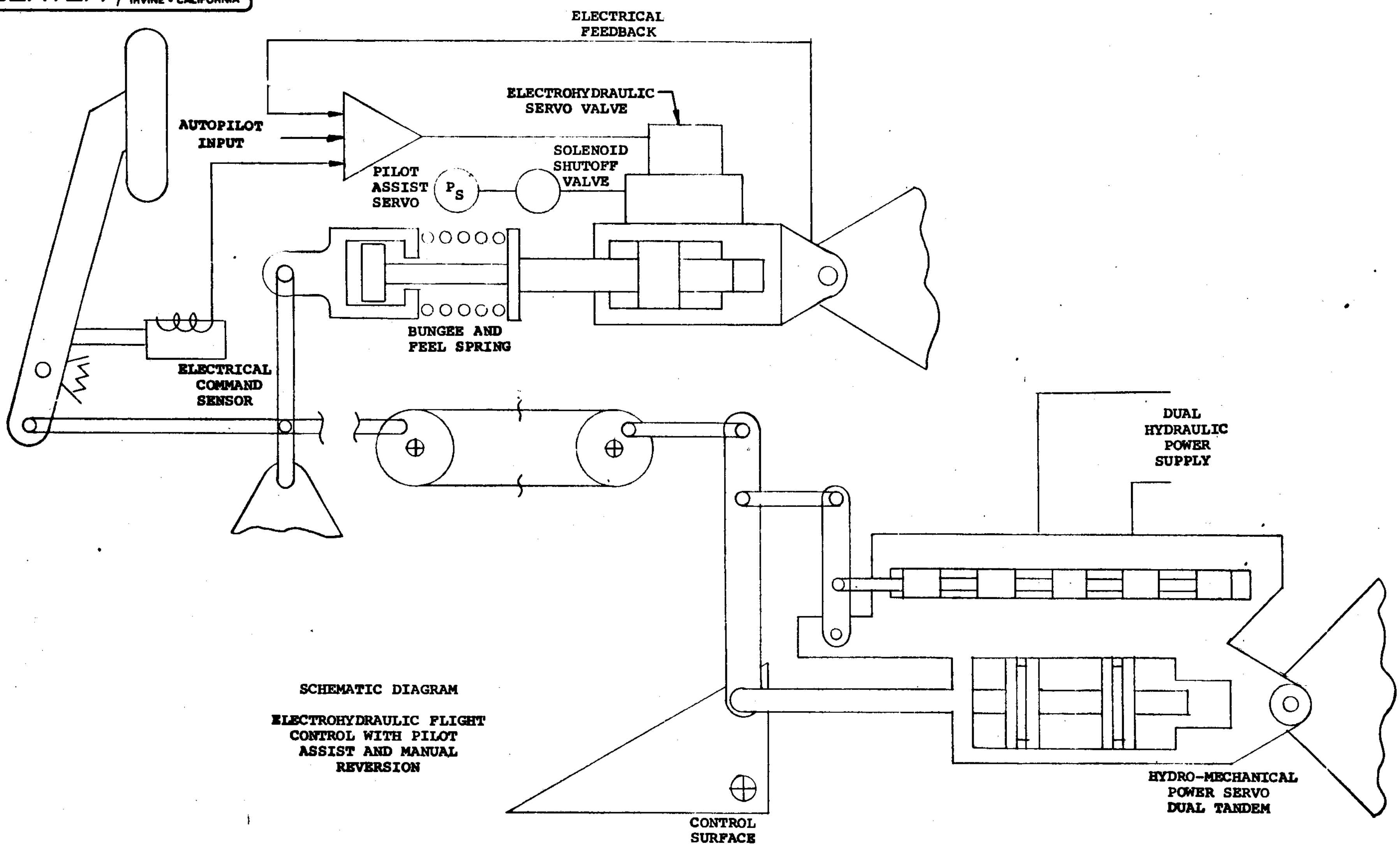

SCHEMATIC DIAGRAM

ELECTROHYDRAULIC FLIGHT CONTROL WITH PILOT ASSIST AND MANUAL REVERSION

246000

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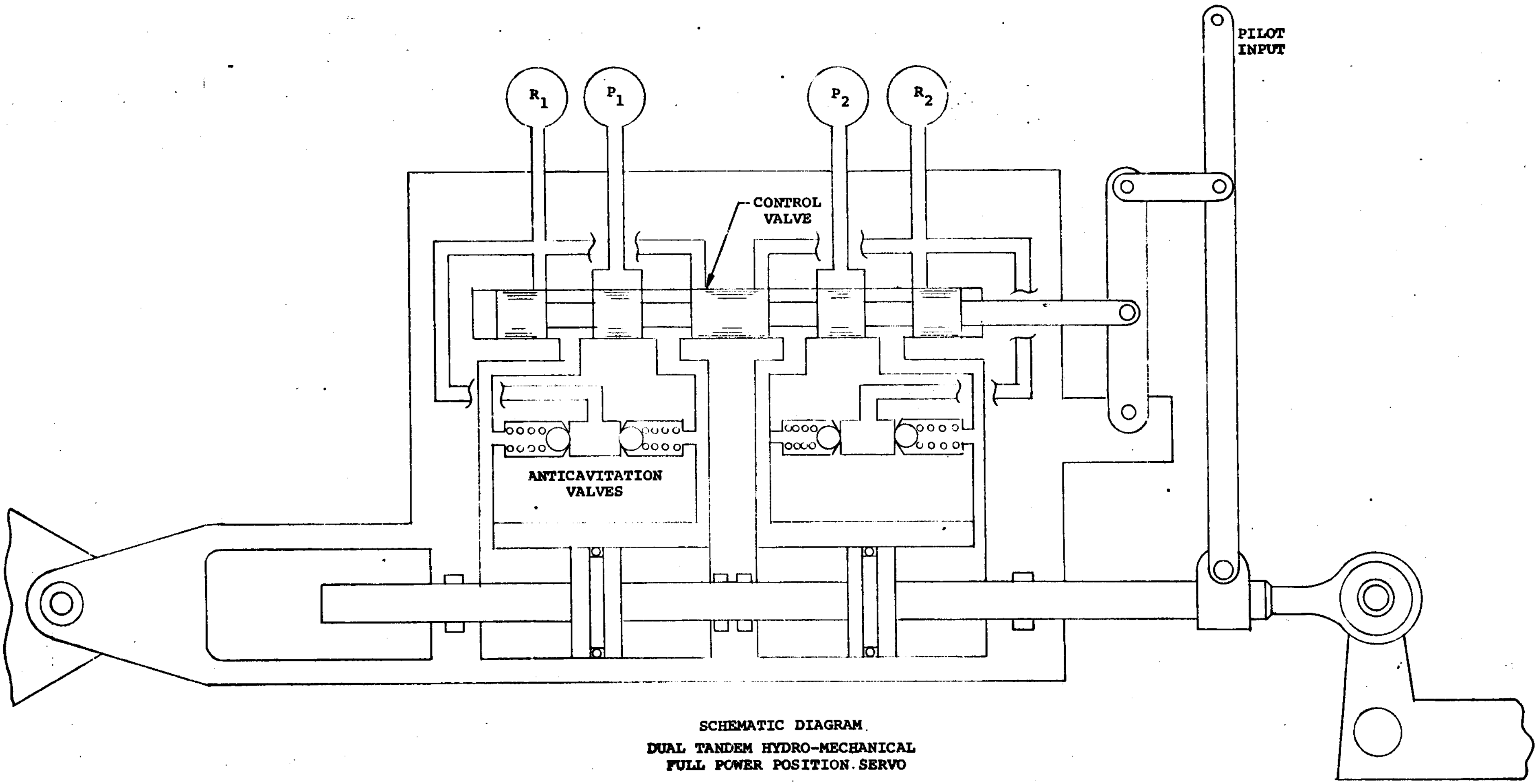
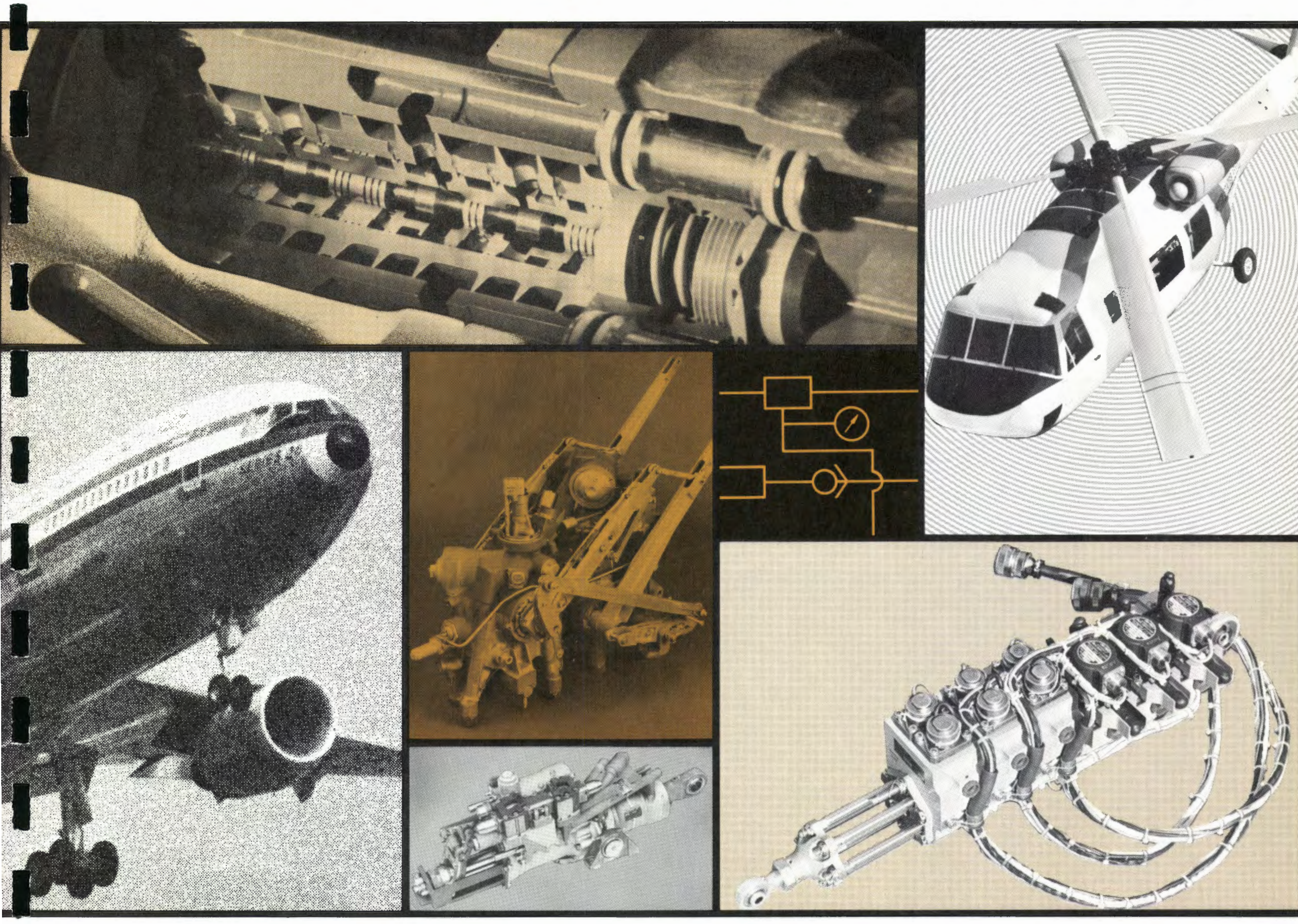


SCHEMATIC DIAGRAM

DUAL TANDEM HYDRO-MECHANICAL FULL POWER POSITION SERVO

246000

LEADER IN FLIGHT CONTROLS



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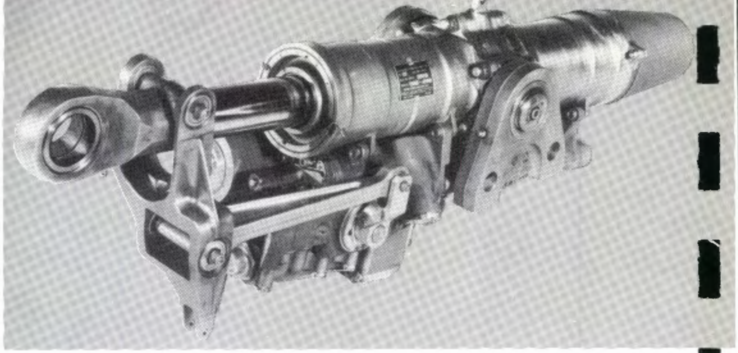
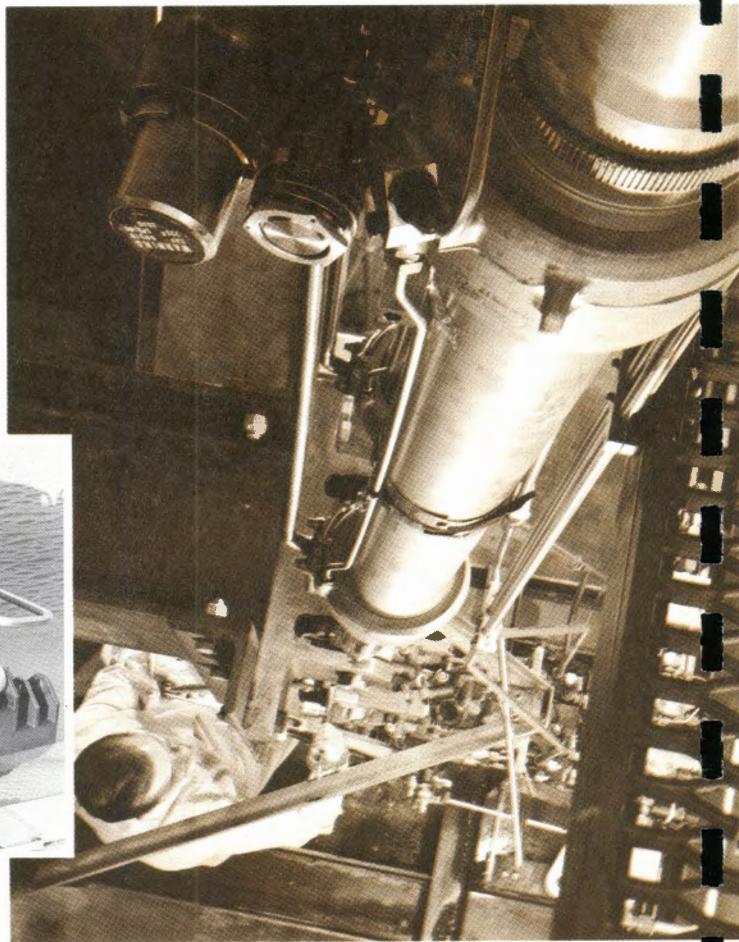
McDonnell - Douglas DC-10 Inboard Aileron Actuator Control Assembly

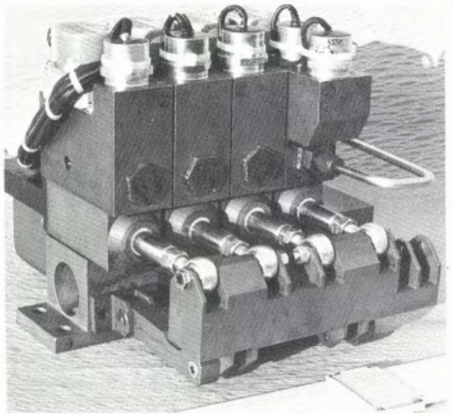


BERTEA CORPORATION

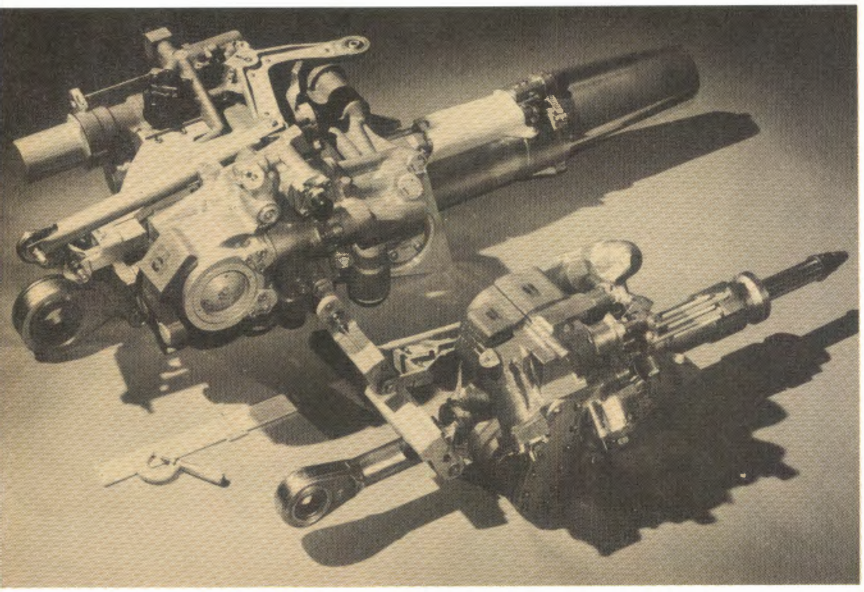
Bertea, a company on the move since its inception in 1939, is the nation's leading producer of precision hydraulic and electrohydraulic servo controls. Our flight control units are principal elements of systems which use hydraulic power for precise control of rudders, elevators, ailerons, and other aerodynamic control surfaces of aircraft.

In the three decades since our inception, the forward look at Bertea has been marked by product innovations and state-of-the-art advancements. Present planning has seen the emergence of a broadened role for the company as a systems oriented manufacturer of high technology, computer supported ultra dependable products involving fluid and electrical technology for a widening spectrum of hardware applications.

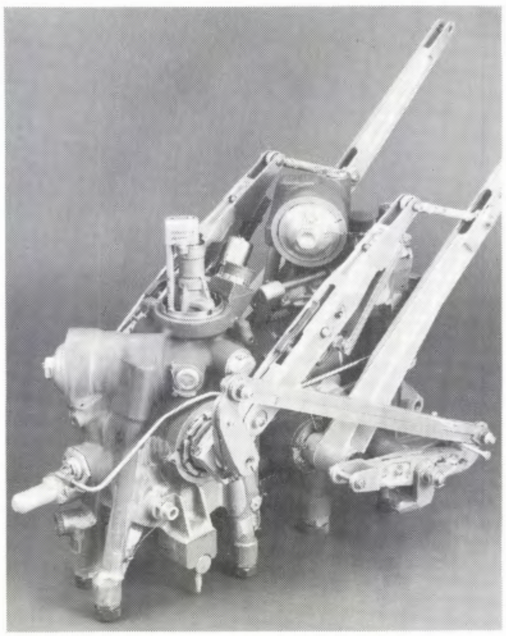




Redundant Electrical Command Actuator for Fly-by-Wire application



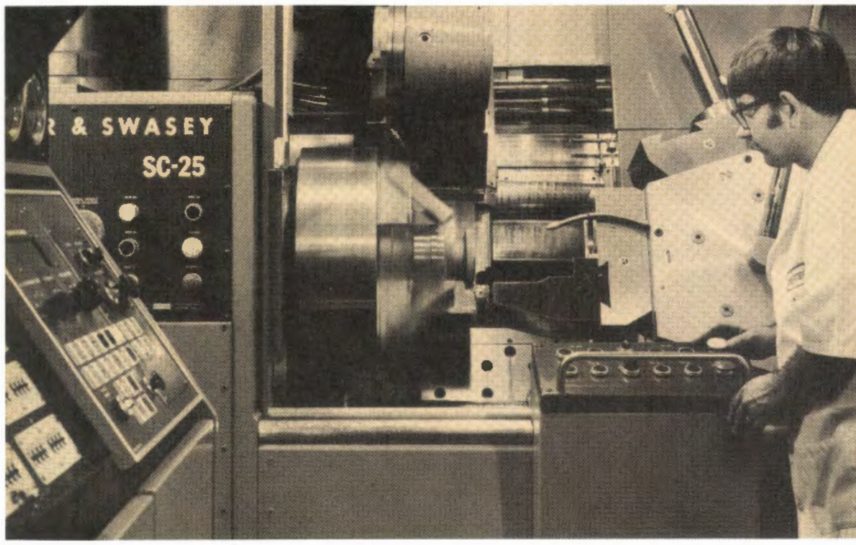
Boeing 747 - Inboard and outboard elevator flight control packages.



Lockheed L1011 - Stabilizer Control Package

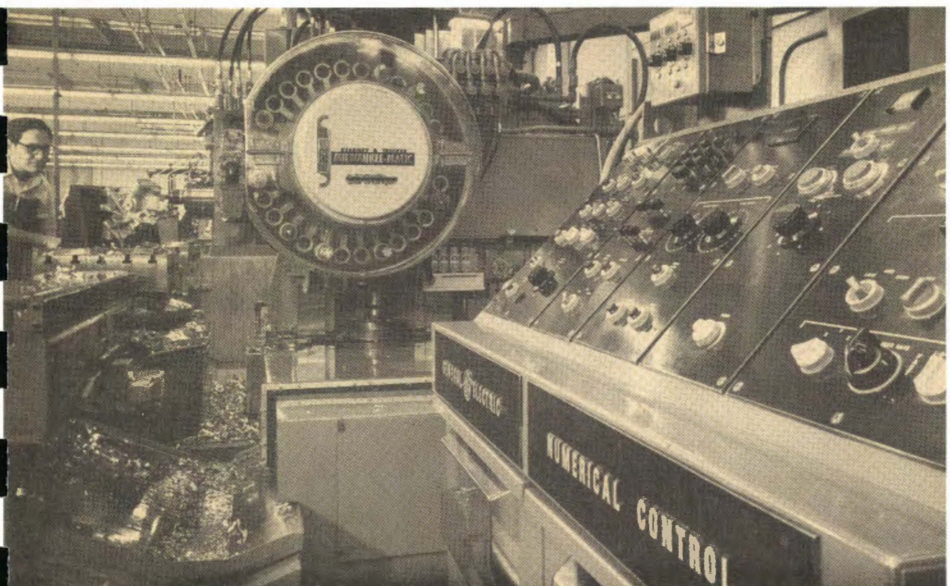
Numerical Control Programming - Perforated tape for automatic machining prepared from engineering drawings, computer programs, and keypunch cards

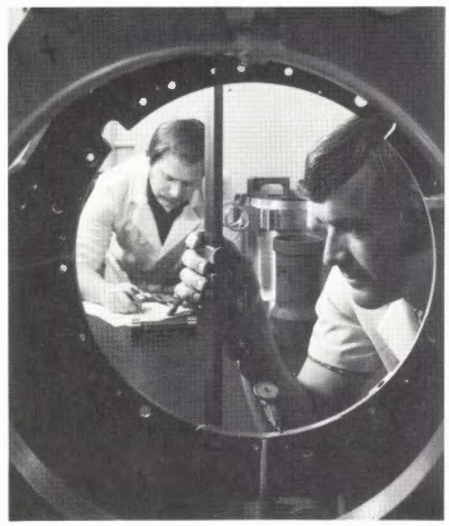
4-Axis Turret Lathe - Using numerical control, this machine performs several automatic turning operations



Qualification testing of L1011 actuator

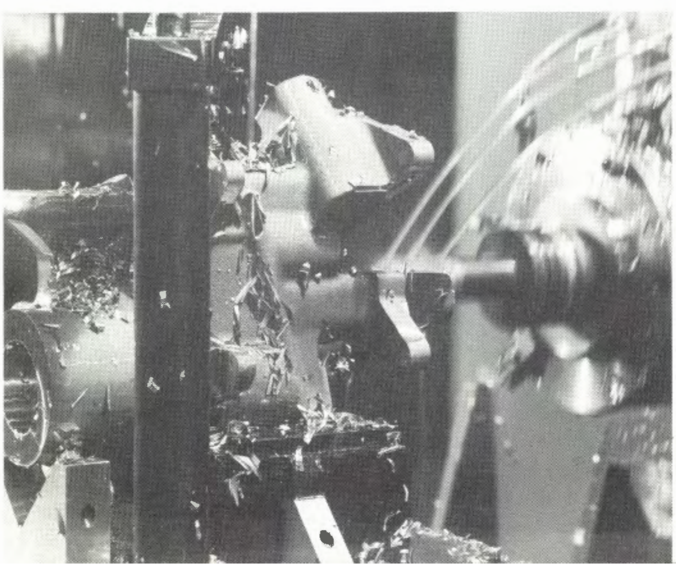
Automatic Tool Control Equipment

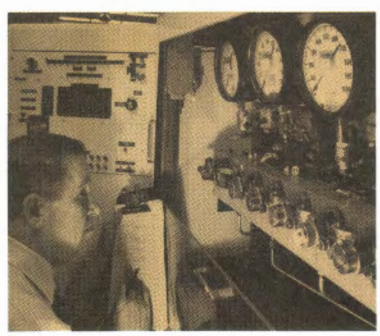




Final Inspection - Exacting quality assurance requirements dictate close inspection of parts for dimensions and finishes

Numerical Control Machining - This machining center performs a complete series of automatic machining operations.





Automatic Solenoid Test Console - Several operational tests are automatically performed on as many as eight solenoids in one test cycle.

TYPICAL PROGRAMS

COMMERCIAL AND CORPORATE AIRCRAFT

BOEING 707
- Brake Deboost Assemblies
- Rudder Power Control

BOEING 727
- Rudder Power Control
- Elevator Power Control
- Brake Deboost Assemblies

BOEING 737
- Rudder Power Control
- Elevator Power Control
- Aileron Power Control

BOEING 747
- Inboard and Outboard Elevator Power Controls

BOEING SST
- Horizontal Stabilizer Power Control

CESSNA CITATION
- Speed Brake/Gear Control
- Dual Check and Flow Detector

DOUGLAS DC-8
- 15 Items of Hydraulic Equipment including:
  - Rudder Power Control
  - Aileron Power Control
  - Main Gear Control
  - Spoiler Power Control
  - Nose Steering Control

DOUGLAS DC-9
- Spoiler Power Control
- Rudder Power Control

DOUGLAS DC-10
- Inboard and Outboard Aileron Power Controls
- Inboard and Outboard Elevator Power Controls
- Upper and Lower Rudder Power Controls
- Spoiler Power Control

GRUMMAN GULFSTREAM II
- Elevator Power Control
- Aileron Power Control
- Rudder Power Control
- Spoiler Power Control

LOCKHEED JETSTAR
- Nose Steering Control
- Flap Control

LOCKHEED L-1011
- Stabilizer Power Control
- Autopilot Servo Actuator

SWEARINGEN MERLIN
- Gear and Flap Actuator Assemblies

SWEARINGEN METROLINER
- Gear and Flap Actuator Assemblies

MILITARY AIRCRAFT

BOEING B-52
- CCV Fly-By-Wire Controls

DOUGLAS A-4
- Elevator Controls

FAIRCHILD A-10
- Powered Flight Controls

GRUMMAN F-14
- Airborne Radar Antenna Positioning Actuator

LOCKHEED C-5
- Aileron Power Control
- Rudder Power Control
- Elevator Power Control
- Pitch Trim Controls

LOCKHEED C-141
- Stabilizer Trim Control

LOCKHEED F-104
- Stabilizer Power Control
- Aileron Power Control
- Rudder Power Control

LOCKHEED P-3
- Aileron Power Control
- Rudder Power Control
- Elevator Power Control
- Nose Steering Control
- Flap Control

LOCKHEED S-3A
- Aileron Power Control
- Rudder Power Control
- Elevator Power Control
- Aileron Trim Actuator
- Rudder Trim Actuator
- Flap Damper
- Mixer Assembly

LOCKHEED YF-12A/SR-71
- Power Flight Controls

McDONNELL F-4
- Rudder Power Control
- Spoiler Power Control

MCDONNELL-DOUGLAS F-15
- Airborne Radar Antenna Positioning Actuator

NORTHROP F-5
- Rudder Actuator
- Elevator Actuator
- Horizontal Stabilizer Actuator
- Stabilizer Augmentation Actuator

ROTARY WING AND STOL AIRCRAFT

LOCKHEED MODEL 286 RIGID ROTOR
- Collective Actuator
- Cyclic Pitch
- Cyclic Roll

LOCKHEED AH-56A CHEYENNE
- Improved Control System
- Advanced Mechanical Control System

BOEING VERTOL
HEAVY LIFT HELICOPTER SYSTEM
- Direct Electrical Linkage System (DELs)
  - Swash Plate Actuator Drivers
  - Frequency Log Dampers

BOEING VERTOL
UTILITY TACTICAL TRANSPORT AIRCRAFT SYSTEM
- (Proposal team member)
- Main Rotor Actuators
- Tail Rotor Actuator

DEHAVILLAND DHC-7
- Spoiler Actuators
- Rudder Actuators

BERTEA
CORPORATION

18001 VON KARMAN AVENUE, IRVINE, CALIF. 92664 · PHONE (714) 833-1424

G. DEVELOPMENT TESTING

Every effort will be made to substantiate the structural elements of the vehicle by analysis. In those cases where it is deemed necessary to confirm analysis with subsequent testing it will be done. These selected assemblies will be static tested as required. It is believed that the conventional Virtus airframe structure will minimize the testing requirements.

Critical panels and certain major joints will be static tested to confirm ultimate load capability. Examples of these are as follows:

1. The fuselage pylon panels at the wing interface
2. The boom to pylon joint
3. The boom to empennage joint

Partial assemblies will be built and used as test articles for this category of testing. The Boeing drop test will be accepted for landing gear verification. The airplane will be designed fail-safe thereby precluding all fatigue cycling test requirements on structural members.

In arriving at test loads aeroelastic effects of the structure will be considered. Allowable load values will be derived from MIL HDBK 5, CAE Stress Memos and applicable agency technical memoranda as required. To confirm analysis and static test results it is planned to install a network of strain gauge instrumentation throughout the first airplane. Flight data will be acquired in this manner for the critical areas.

Proof and operational testing of major mechanical systems will also be part of the program. In the case of the control system it will involve

G. Development Testing (Continued)

electro mechanical components, hydraulic systems and redundancy verification.

Without a hangar large enough to accomodate the Virtus for ground vibration testing, the test must be performed outdoors. Not including control surface modes, approximately ten symmetric modes and ten antisymmetric modes should be measured for the empty and full fuel configurations.

Two methods will be employed for obtaining vibration mode data. In both cases, the flight flutter test instrumentation system will be used to record motion and strain data for the aircraft. The first method will require a drop test or similar means of impulse type excitation so that Fast Fourier Transform Analyses of the recorded data will provide frequencies of the excited modes. Further Fourier Analyses to obtain better mode shape data will be performed once the natural frequencies are determined satisfactorily. The second method will be conventional excitation by electromagnetic shakers located at the wing tips and the aft sections. Mode shape data will be obtained at resonances and the shaker locations will verify the effectiveness of vane excitation to be used for flight flutter testing.

It is recommended that a limited ground vibration test of the Virtus with Orbiter be considered to verify analytical predictions prior to first flight.

Flight flutter testing will be performed for the required altitude-speed regime utilizing oscillatory aerodynamic vane type excitation on the wing tips and empennage. It is assumed that this system will be GFE.

G. Development Testing (Continued)

The instrumentation system to be used for determination of mode shapes will include strain measurement, as well as accelerometers and/or velocity pickups.

ASSESSMENT OF FACILITY AND MANUFACTURING REQUIREMENTS FOR A DESIGN AND MANUFACTURING TEAM TO ECONOMICALLY PRODUCE THE PROPOSED AIRCRAFT

The entire management and engineering team, which was responsible for the development of the Pregnant Guppy and the Super Guppy, and which subsequently had the responsibility for the development of the Mini Guppy and an out-sized version of the Canadair CL-44, is still available for the new task of producing the Virtus. All members of this team have been consulted and have contributed to this study. It is the unanimous opinion of the members of this team that the location for the manufacture of the Virtus should be at a site along the southern California coastal area. This opinion has been dictated for several reasons:

1. Climate—Construction, and utilization of construction facilities as an operational maintenance base, will be semi out-of-doors operations. Therefore, various expansion coefficients between fixtures and construction materials and climatic working conditions are quite important factors requiring consideration. Consequently, southern California coastal temperate climate is considered to be *highly* desirable and cannot be equaled at any other area in the country.

2. Proximity of aerospace suppliers—The southern California area is well known for its concentration of aerospace industries. No other locale in the United States can provide, within a 200 mile radius, the reservoir of aircraft engineering and manufacturing personnel. Within this same area can be found the majority of industry sources of supplies and components necessary for the construction of the Virtus. The concentration and proximity of these suppliers becomes more vitally important when consideration is given to the time schedule required for the construction of this aircraft.

We are familiar with all of the airports in the southern California coastal area and, as a part of this study, have visited those which we consider to be suitable for the construction and maintenance of the Virtus. Our choices are listed below in order of preference:

1. Oxnard Air Force Base, Oxnard, California.
2. Pt. Mugu Naval Air Station, Oxnard, California.
3. Miramar Naval Air Station, San Diego, California.
4. Brown Field, San Diego, California.
5. Santa Barbara Airport, Santa Barbara, California.

Oxnard Air Force Base, our first choice, has been closed and is presently inactive. It is expected that it will soon be turned over to Ventura County, at which time it should become available for commercial operations. There is a possibility of litigation ensuing from a local community, however, this matter will either be resolved by agreement within a short period of time or, if litigation does ensue, we would forget this location.

continued.

Pt. Magu Naval Air Station is located only a few miles from Oxnard Air Force Base and is also an ideal location for this project. Both of these locations are less than an hour's driving time from the San Fernando Valley, which would provide an excellent labor pool and source of supplies. Both are less than 20 minutes flying time from Palmdale Air Force Base, the Orbiter assembly site. We believe that it would be feasible to construct a facility on an unused portion of Pt. Mugu Naval Air Station, or on private property adjacent to the base with access to the runway. The limited type of operation should present no conflict with Naval operations and there are many precedents for this type of military/ civil joint-user facilities. The Navy should support the Virtus program because they are certain to have requirements for an aircraft with this capability (i.e., submarine rescue craft, parts for disabled vessels, aircraft, and helicopters).

Miramar Naval Air Station presents the same joint-user potential as described for Pt. Mugu Naval Air Station.

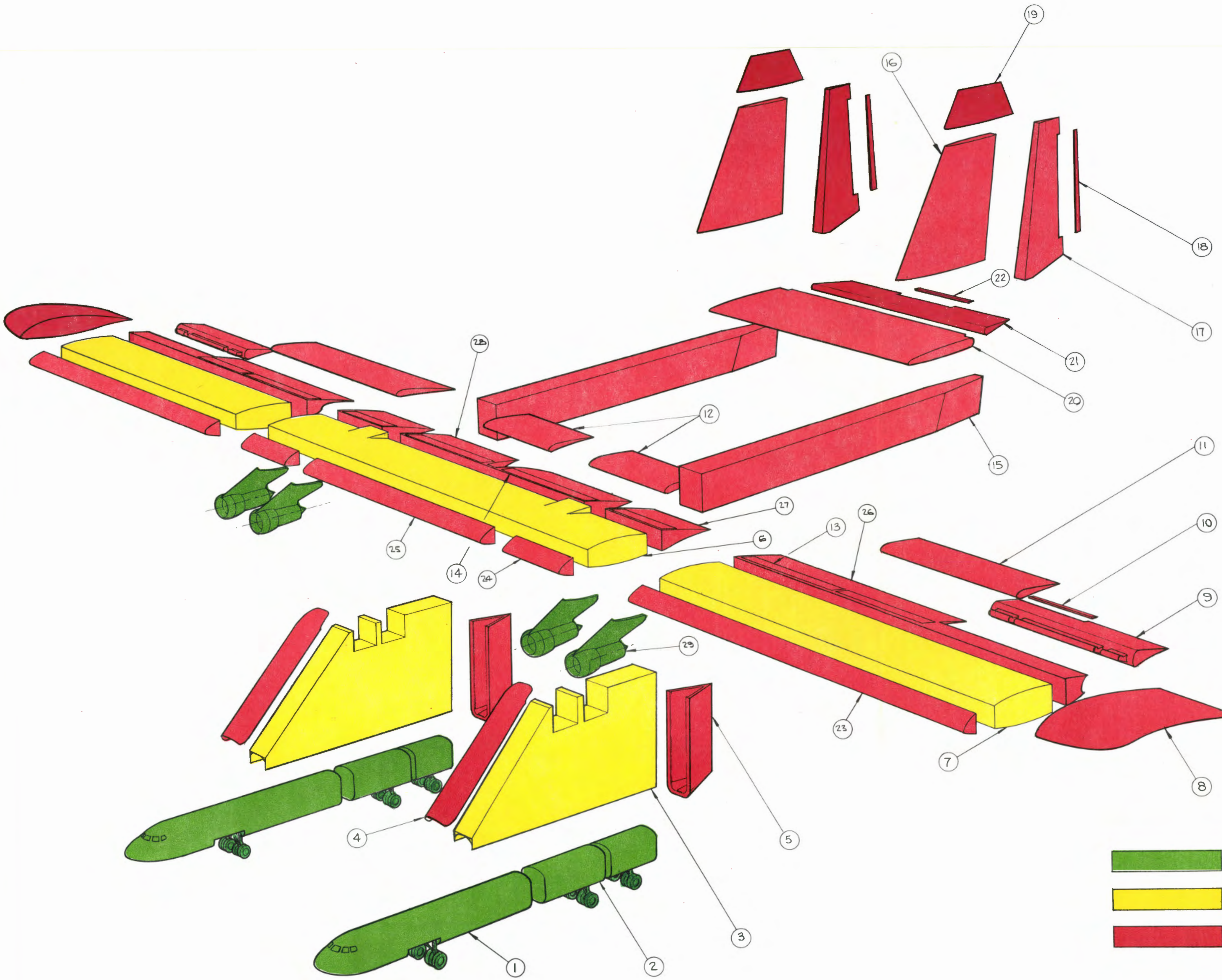
Both Miramar and Brown Field are located approximately 30 minutes' driving time from San Diego. San Diego also provides an excellent source of aerospace labor and suppliers and ideal climatic conditions.

Santa Barbara's major asset is the existence of the Aero Spacelines hangars, which are unused at the present time. These hangars, however, would not be large enough for final assembly and this, coupled with a shortage of available, skilled aerospace labor, has caused us to list this as the last choice of our selections.

We believe that the most economical approach to a facility would be to build one designed for Virtus construction. At first, this might appear to be a costly approach, to amortize perhaps 75% of a facility cost in the construction of only 2 aircraft. It makes economic sense, however, when consideration is given not only to the lease cost of an existing facility but, also, to the money which could be saved during the course of construction of the 2 aircraft by using a facility designed specifically for the purpose. The facility would then serve as a maintenance base for the aircraft, which we prognosticate will be in use for 25 years.

Our construction concept envisions approximately half of the aircraft to be manufactured by sub-contractors. This approach, by reducing in-house manufacturing and thereby minimizing organizational build-up, along with the use of B-52 and other 'off-the-shelf' components, we believe is the secret of being able to produce the first aircraft in two years from go-ahead. The following page depicts a blow-up drawing of the aircraft and its components showing those planned for sub-contracting. The majority of these components are simple structures, which qualified sub-contractors should have no problems in producing within the required time limits. We would plan utilizing a leased, corporate, twin engined aircraft to provide regular monitoring of sub-contractor progress by our engineering and manufacturing specialists. This would assure us of proper inter-facing quality control, as well as schedule adherence. In the event a sub-contractor is deficient in either of these areas and was unwilling, or unable, to take corrective action, we would reserve the right to remove the hardware, including tooling, and either complete the manufacturing of the part in-house, or assign it to another sub-contractor. The major components, including the tail booms and vertical and horizontal stabilizers, would have full time surveillance by our engineering and production specialists.

The following pages also depict concepts for a facility and methods of construction and assembly.



29 ENGINES & PYLONS PRATT & WHITNEY JT9D-3A TURBOFAN
28 WING TRAILING EDGE CENTER SECTION
27 WING TRAILING EDGE CENTER SECTION LEFT & RIGHT HAND SIDE
26 WING TRAILING EDGE OUTBOARD PANEL LEFT & RIGHT HAND SIDE
25 WING LEADING EDGE CENTER SECTION
24 WING LEADING EDGE CENTER SECTION LEFT & RIGHT HAND SIDE
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20 HORIZONTAL STABILIZER
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15 BOOM LEFT & RIGHT HAND SIDE
14 WING SPOILERS CENTER SECTION LEFT & RIGHT HAND SIDE
13 WING SPOILERS OUTBOARD PANEL LEFT & RIGHT HAND SIDE
12 WING FLAPS CENTER SECTION LEFT & RIGHT HAND SIDE
11 WING FLAP OUTBOARD LEFT & RIGHT HAND SIDE
10 AILERON TRIM TAB LEFT & RIGHT HAND SIDE
9 AILERON LEFT & RIGHT HAND SIDE
8 WING TIP LEFT & RIGHT HAND SIDE
7 WING OUTBOARD PANEL LEFT & RIGHT HAND SIDE
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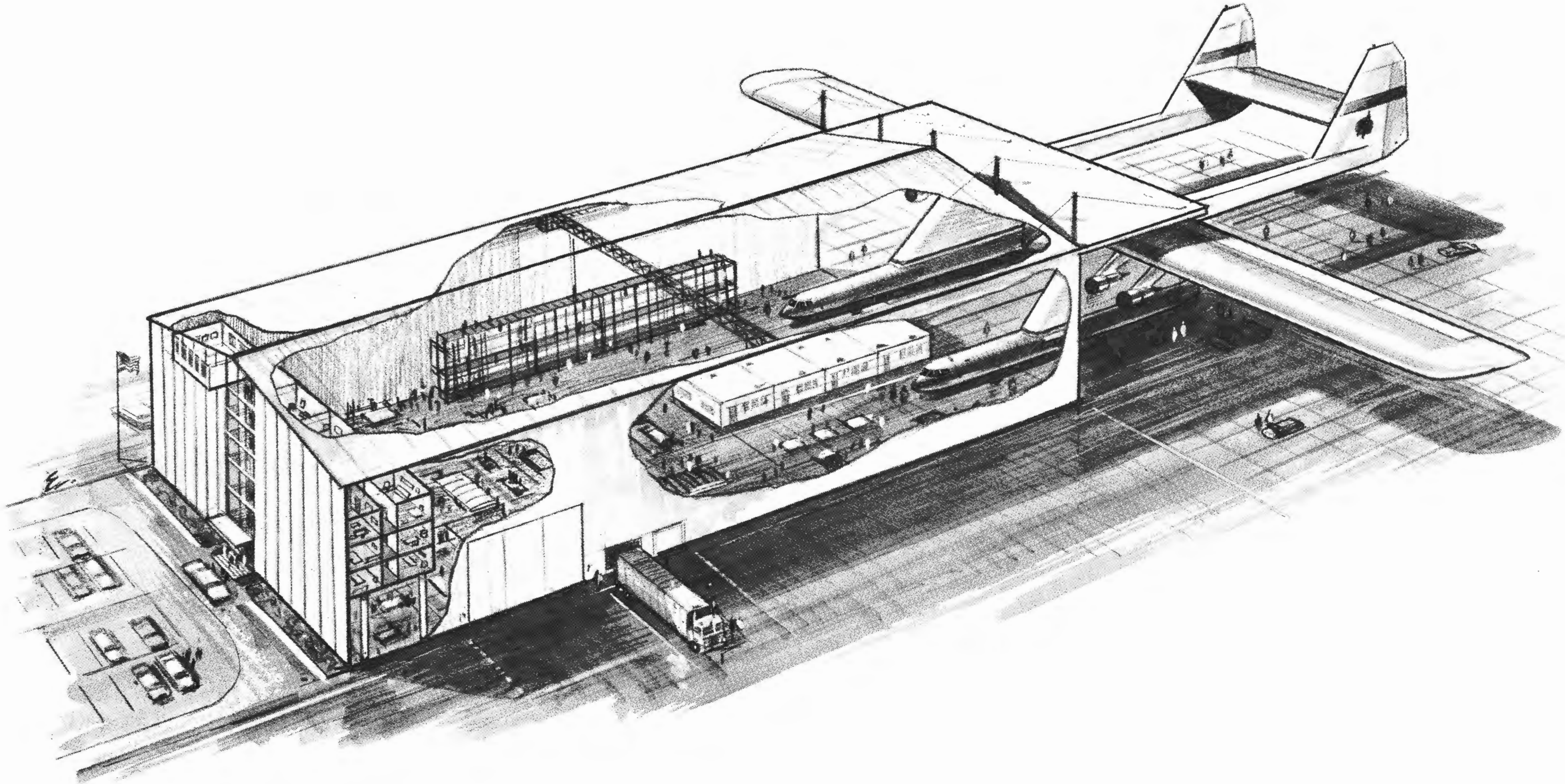
5 PYLON FAIRING AFT LEFT & RIGHT HAND SIDE
4 PYLON FAIRING FORWARD LEFT & RIGHT HAND SIDE
3 PYLON SUPER STRUCTURE LEFT & RIGHT HAND SIDE
2 B-52 LANDING GEAR SECTION MODIFIED LEFT & RIGHT HAND SIDE
1 B-52 FWD FUSELAGE MODIFIED LEFT & RIGHT HAND SIDE

1 B-52 & OFF-THE-SHELF POWER PACKAGES & PYLONS

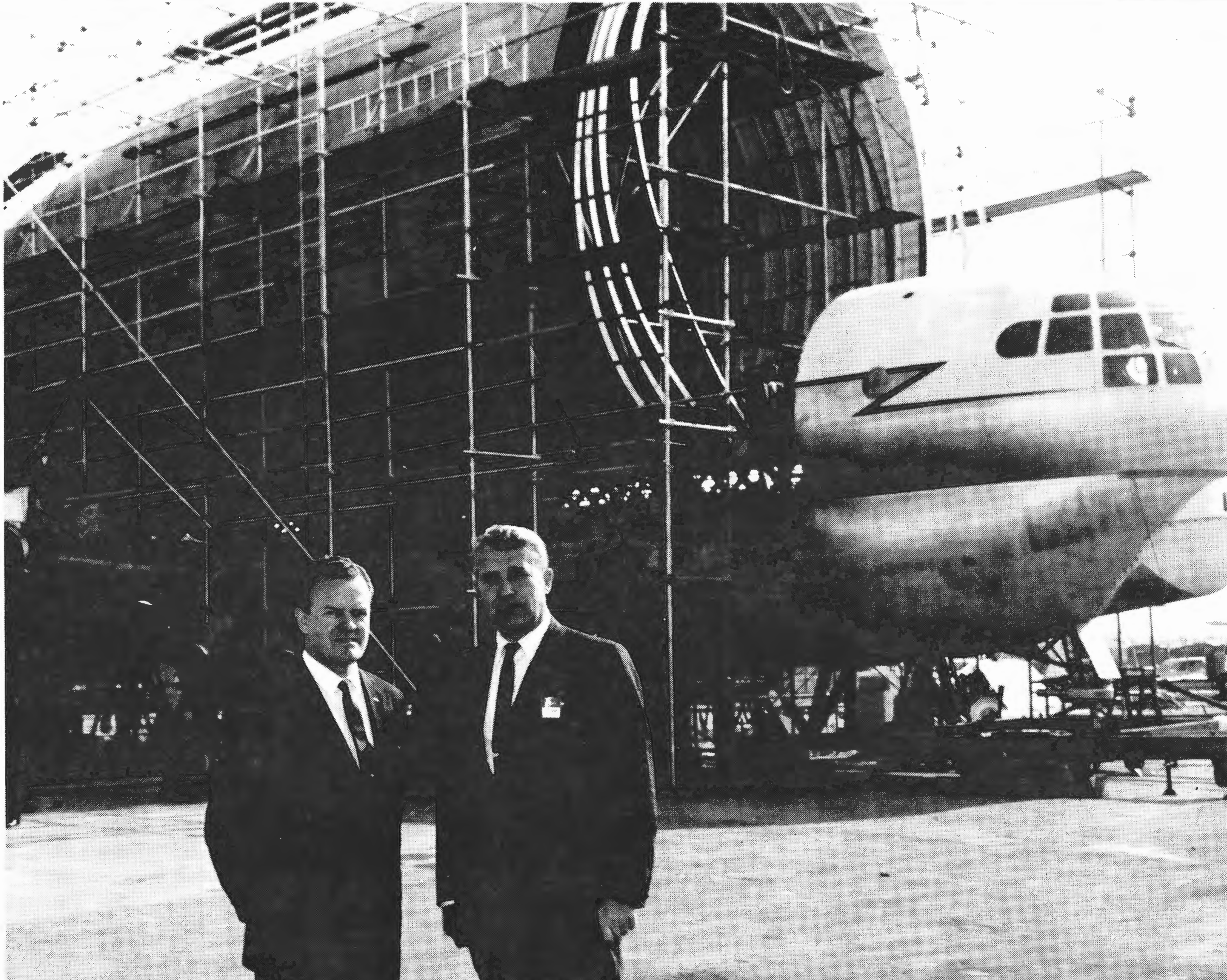
2 IN-HOUSE CONSTRUCTION

3 SUB-CONTRACTED COMPONENTS

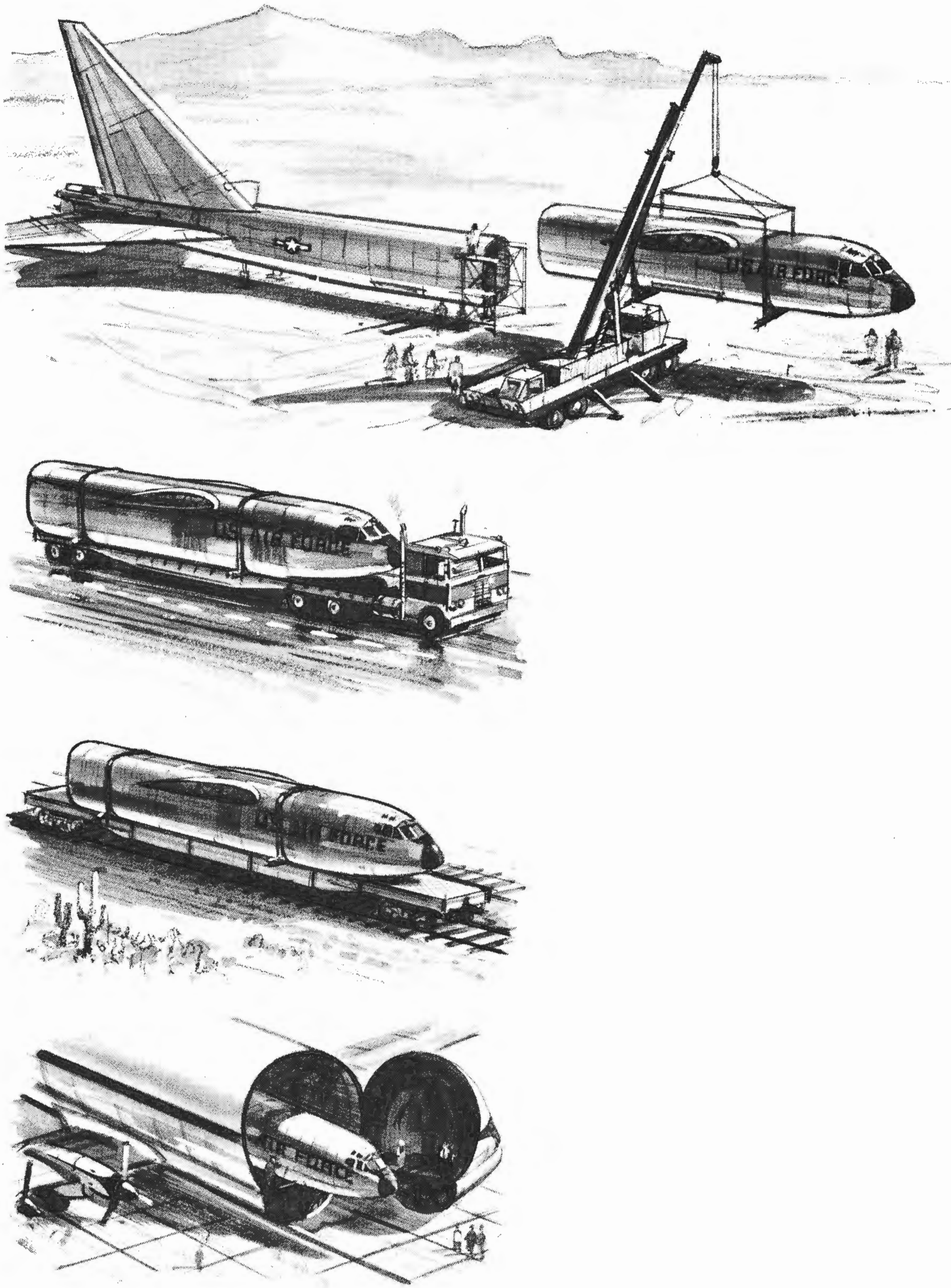


MANUFACTURING FACILITY

The portrayed manufacturing facility is designed specifically for the construction, sub-assembly and final assembly of the Virtus. In the left end of the hangar are manufacturing and sub-assembly locations and areas for machine, hydraulic, sheet metal, and electrical shops. Shown in the center of the hangar floor between the fuselages are the tool crib, engineering, drafting, and manufacturing offices. There are two 35 ton capacity overhead cranes on a traveling boom. The overhang, pictured on the right side of the facility, would provide shelter during performance of routine maintenance operations.

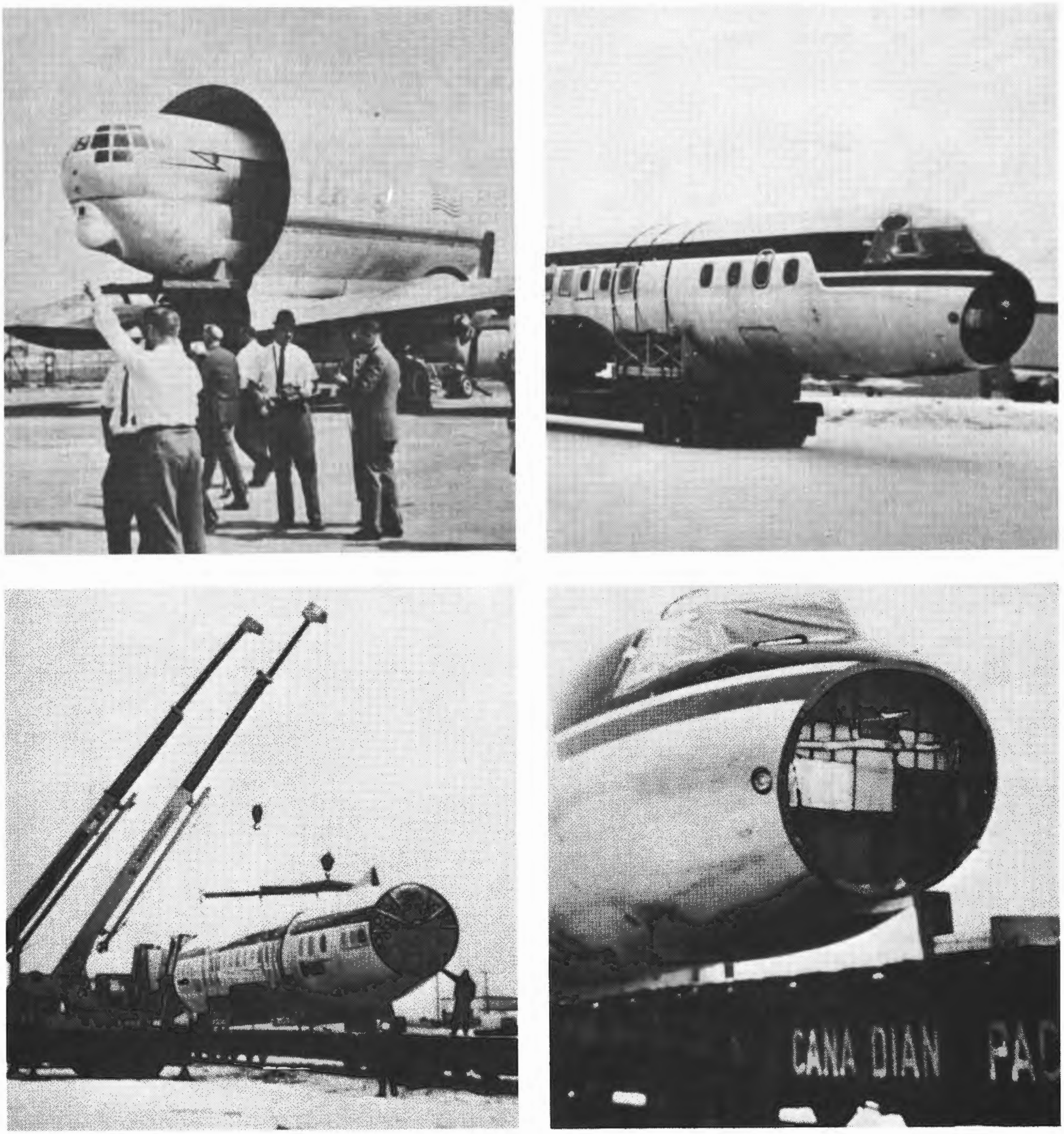


'JACK' CONROY and DR. WERNHER VON BRAUN with out-of-doors construction of 'Super Guppy' in background. Aircraft was developed, from conception to first flight, in eight months.



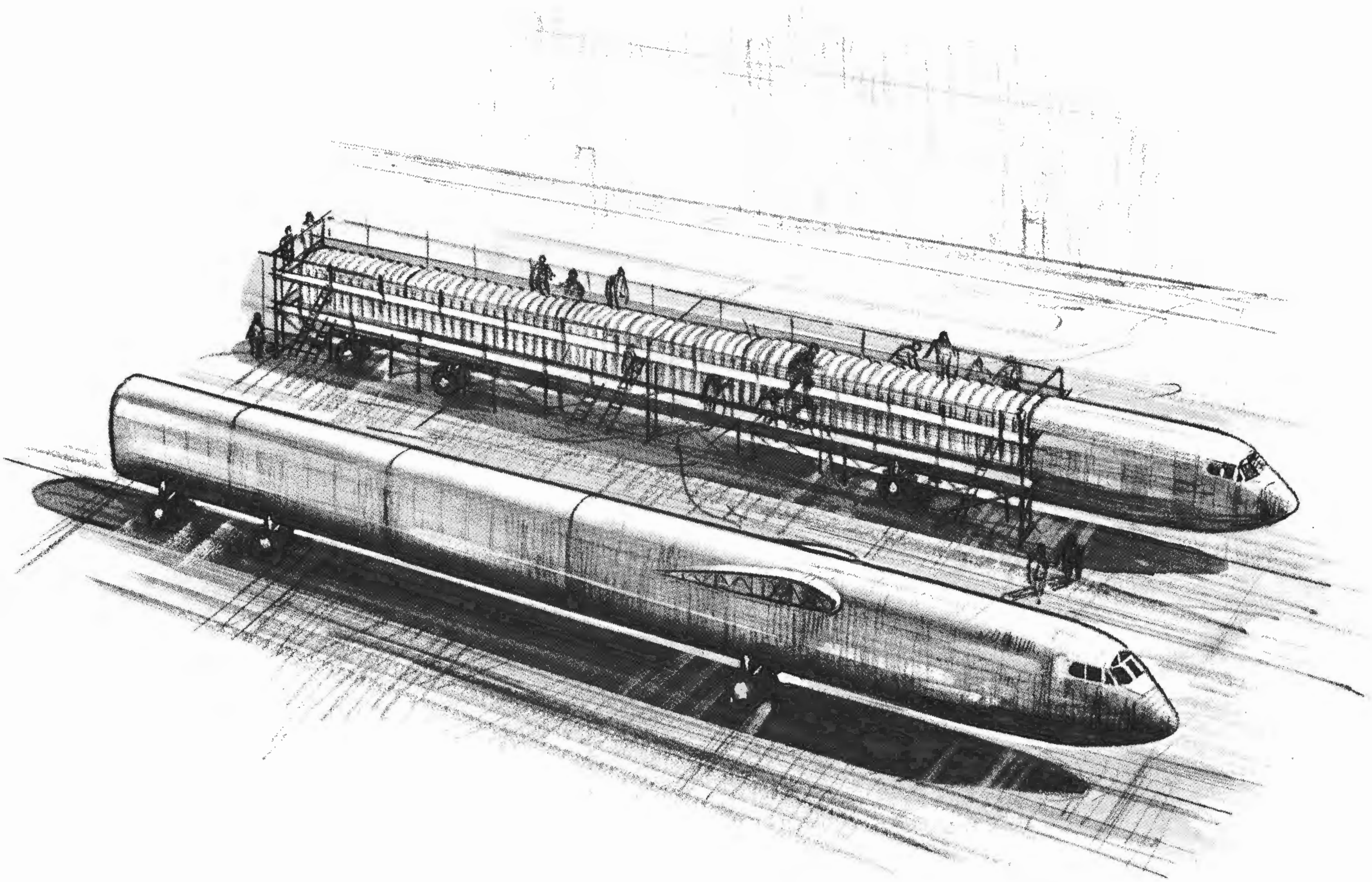
B-52 DISASSEMBLY AND SHIPPING

Pictured is the disassembly of a B-52 at Davis Monthan Air Force Base at Tucson, Arizona. The required fuselage sections would then be shipped to the Virtus manufacturing site via truck, rail, or "Guppy" aircraft.



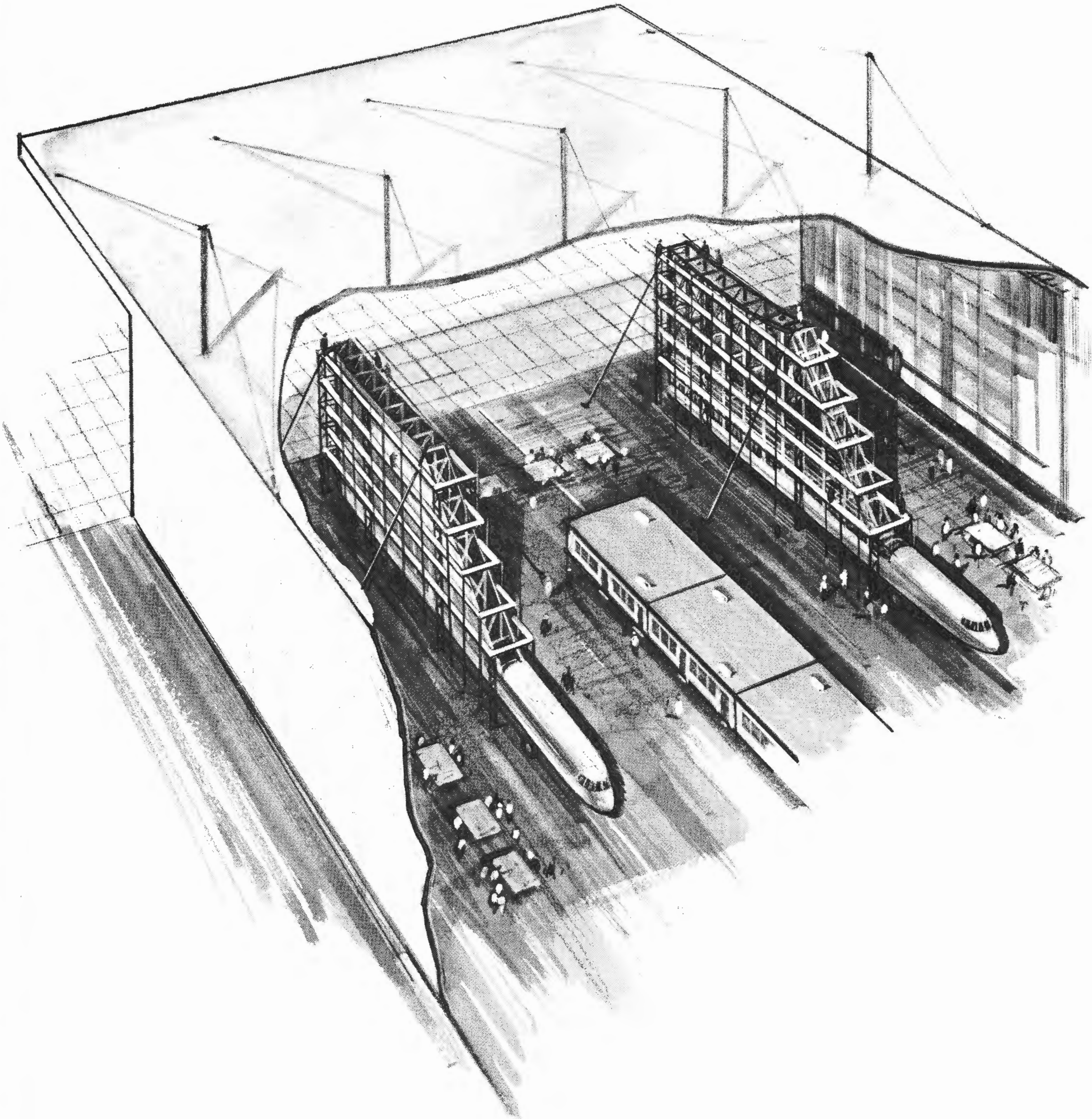
AIRCRAFT FUSELAGE TRANSPORTATION

Photos showing actual transportation of aircraft fuselages sections via guppy, trailer, and rail. These fuselages are larger than equivalent B-52 sections.



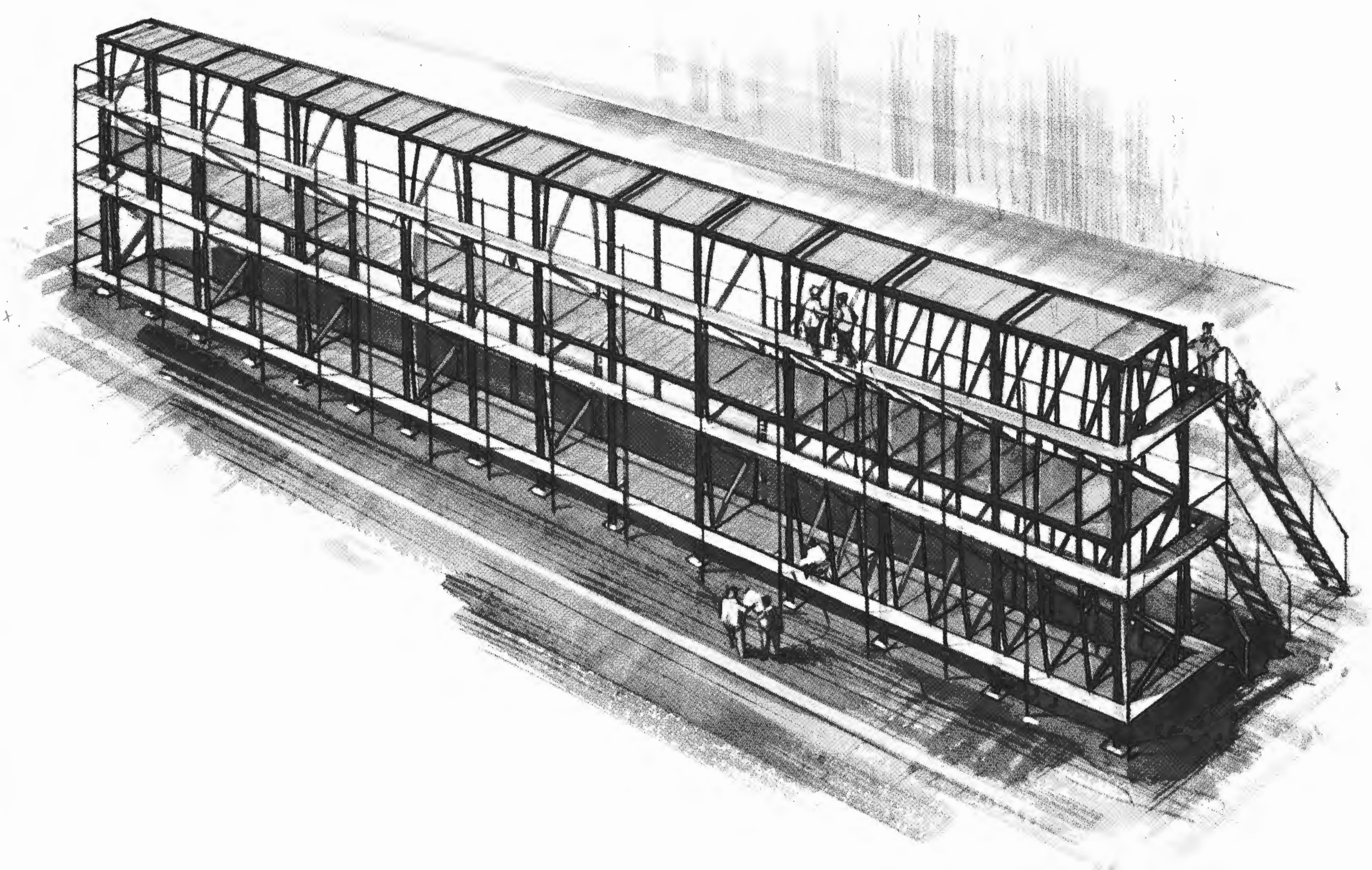
B-52 FUSELAGE REASSEMBLY AND MODIFICATION

The B-52 fuselage sections would be reassembled (note the extra rear landing gear section) and a cargo compartment would replace the bomb bay and fuselage fuel tank areas. The cockpit areas would be reconfigured by the elimination of military stations and equipment, with special attention being given to a weight reduction program. In the upper fuselage shown in the artist's drawing, the B-52 fuselage skin has been removed in preparation of commencing construction of the fuselage pylon section.



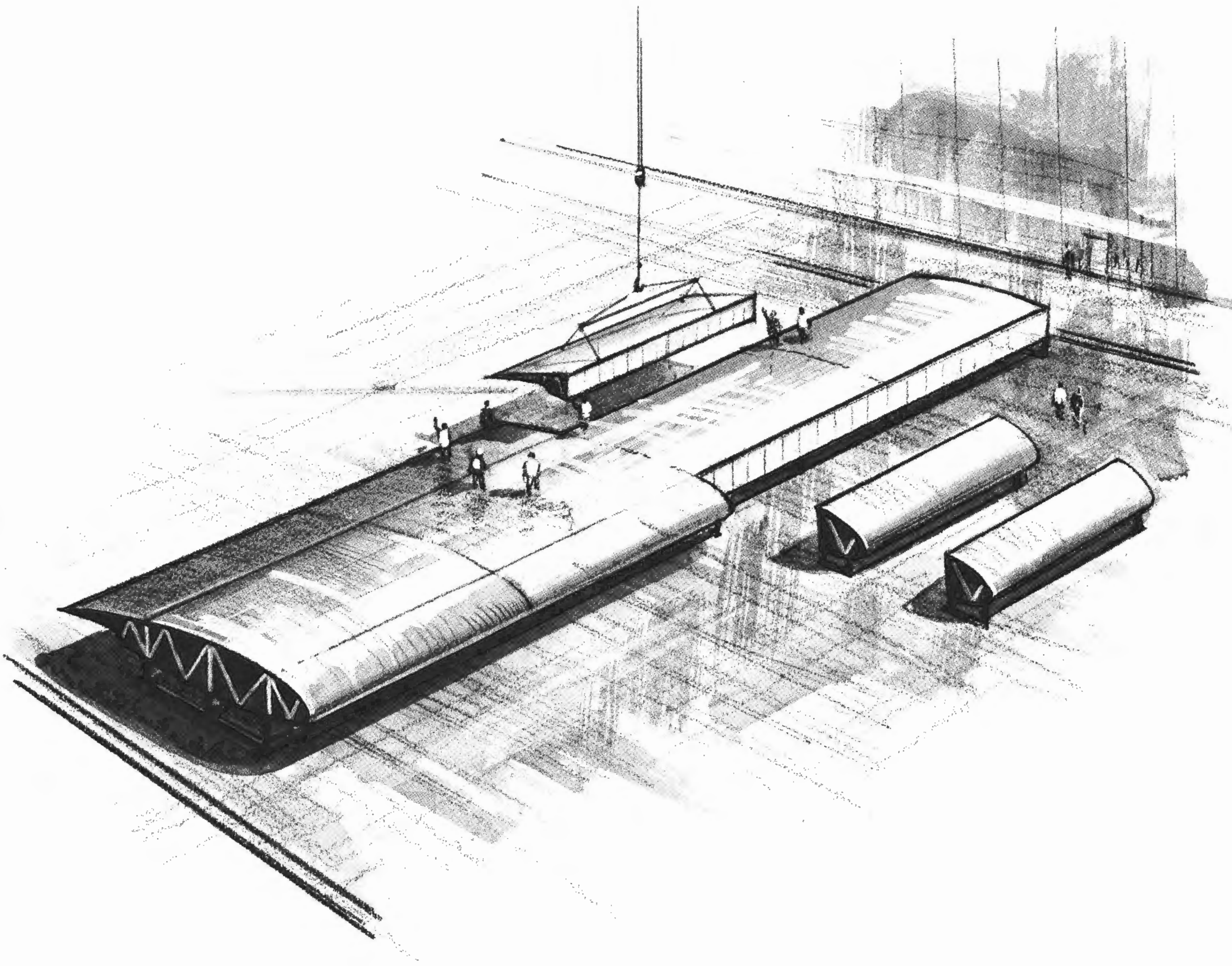
FUSELAGE PYLON SECTIONS MANUFACTURING

The fuselage pylon sections will be manufactured by attachment of vertical and diagonal members to B-52 fuselage frames. Construction will be from multi-level scaffolding similar to that used in the construction of the "Guppy" airplanes. Three primary beam sections will transmit the loads from the three wing spars to the B-52 aft gear structure. Loads to the forward gear will be carried by the forward structure of the fuselage pylon section. Scaffolding will be equipped with electric lifts to reduce personnel time in transit between floor and upper levels.



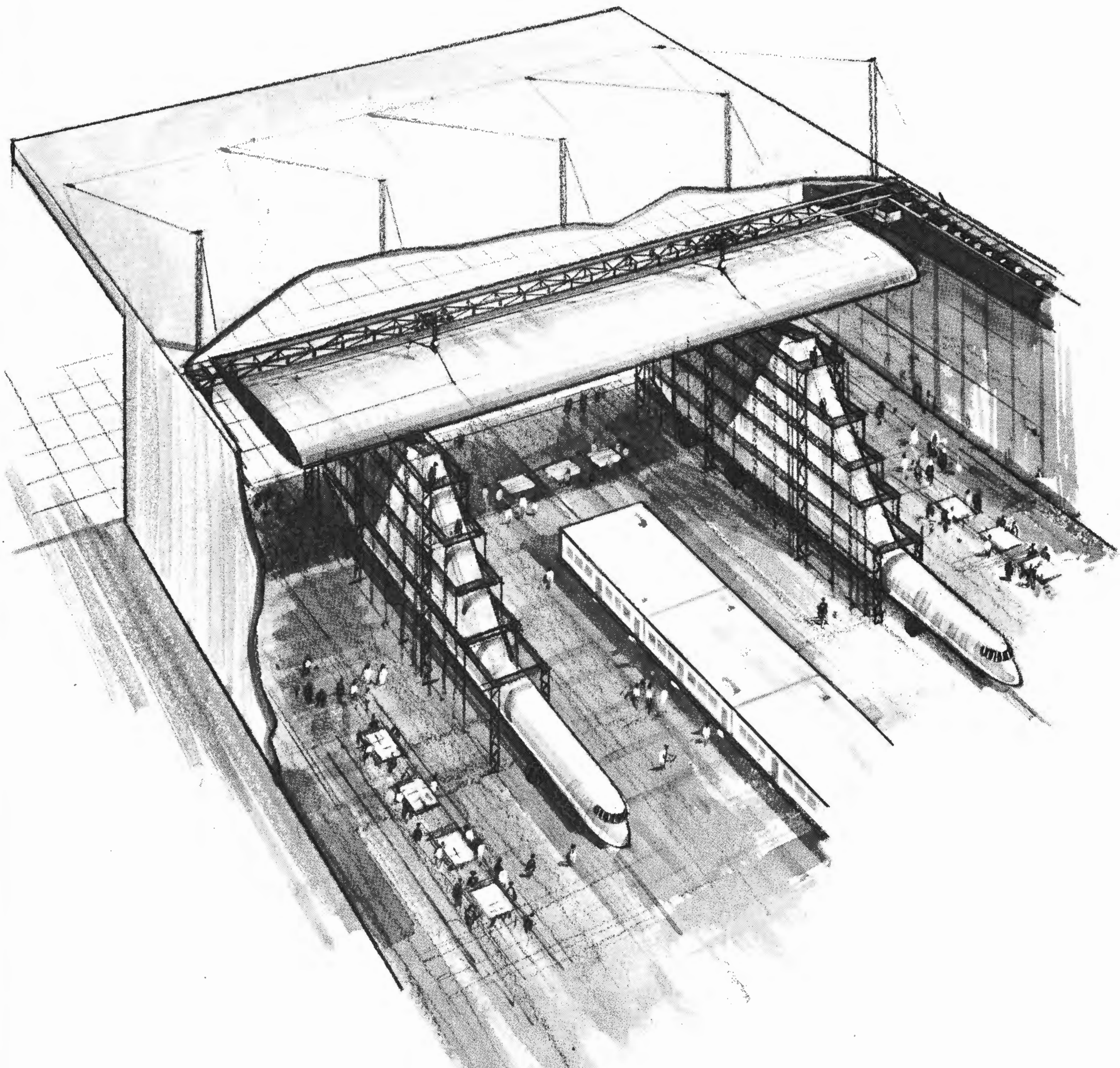
WING CENTER-SECTION BOX FABRICATION

The wing center-section box would be constructed in-house in the manufacturing section of the facility. The artist's drawing shows the three spars in the holding fixture and ribs being placed in position.



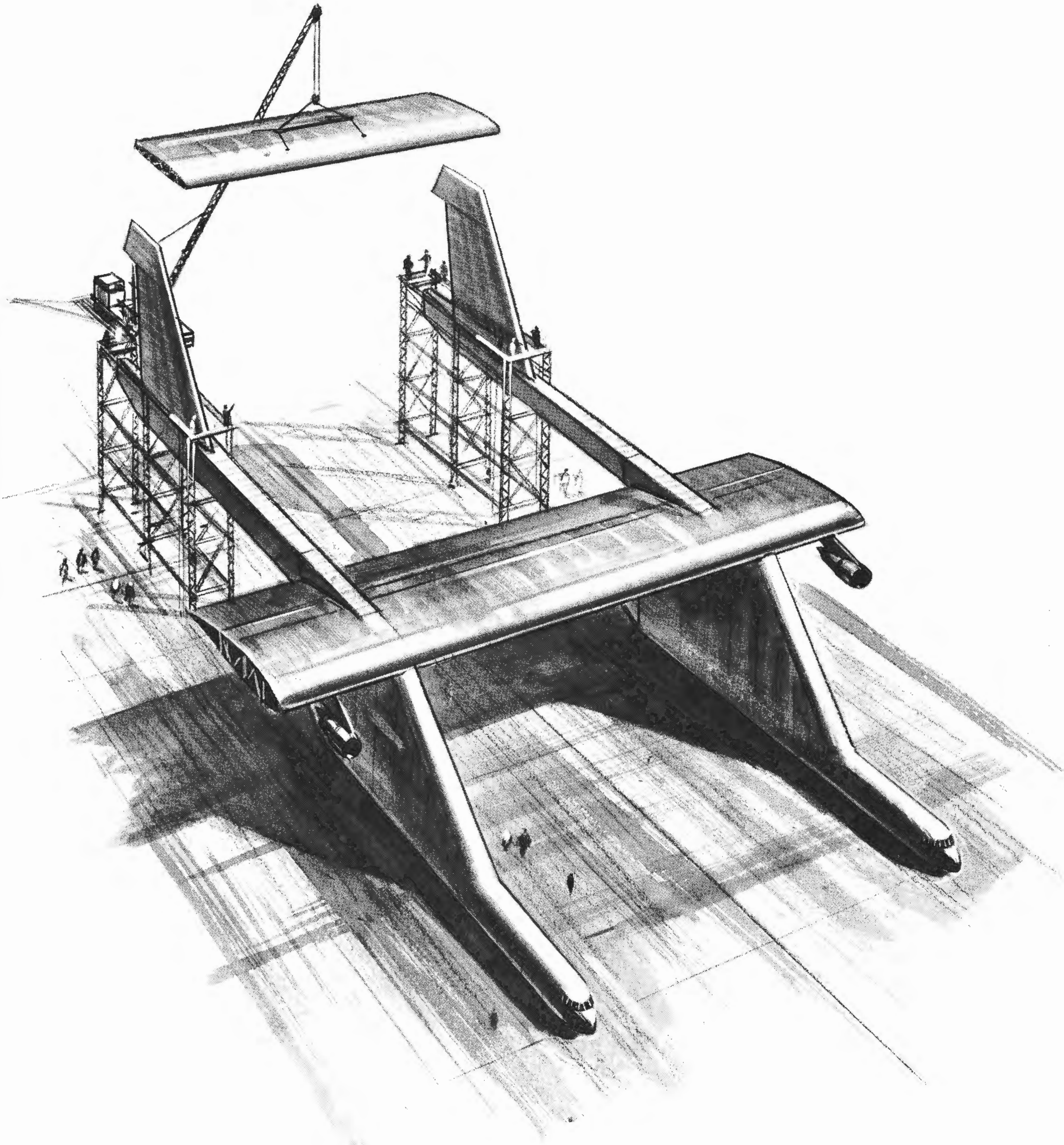
SUBASSEMBLY OF WING CENTER SECTION

Shown is the attachment of the wing center section leading and trailing edge segments. It is planned to sub-contract the manufacturing of these segments, however, consideration will also be given to manufacturing in-house.



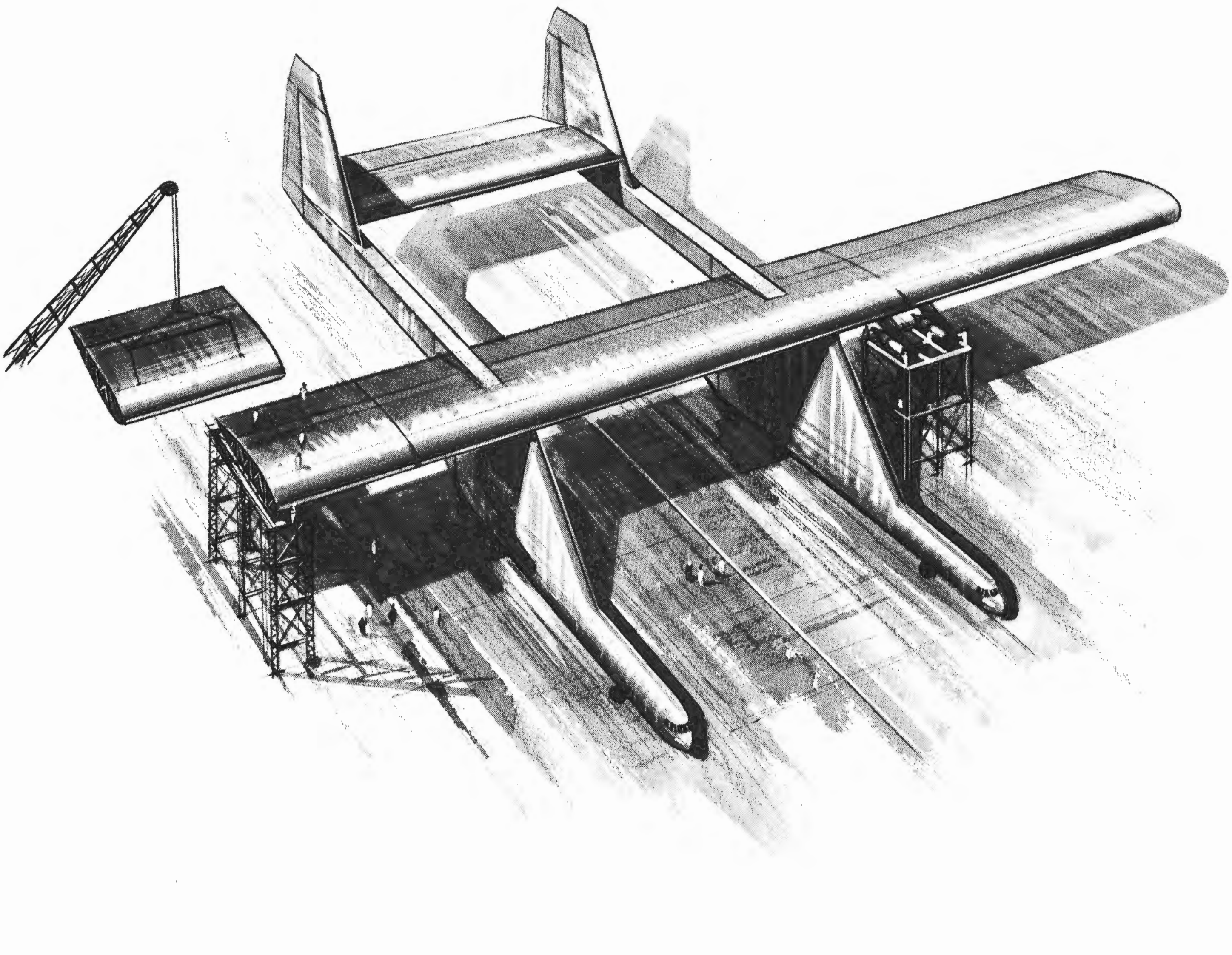
PLACING OF WING CENTER SECTION

The wing center section is shown being lowered by the overhead crane system into position for mating to the fuselage pylon sections. Following this mating, the tail booms will be attached, completing the indoor assembly.



EMPENNAGE ASSEMBLY

Shown in the drawing is the horizontal stabilizer being lowered into position for attachment to the vertical stabilizers, which have already been placed. Following this operation, the rudders and elevator will be attached in the same method. These operations will be conducted out-of-doors and should not require more than a few days time, using our "Erector Set" approach.



OUTBOARD WING PANELS AND ENGINE ATTACHMENT

The final steps of the structural assembly include the attachment of the 40 foot outboard wing panels (3 on each side) and attachment of engine pylons and Q.E.C.'s. The left wing is complete and the number 1 and 2 engines are being attached. At this point, the aircraft forward section and center wing can be towed under the facility overhang for systems installation and pre-flight check-out.

ESTIMATED AMOUNT OF
GOVERNMENT FURNISHED EQUIPMENT REQUIRED

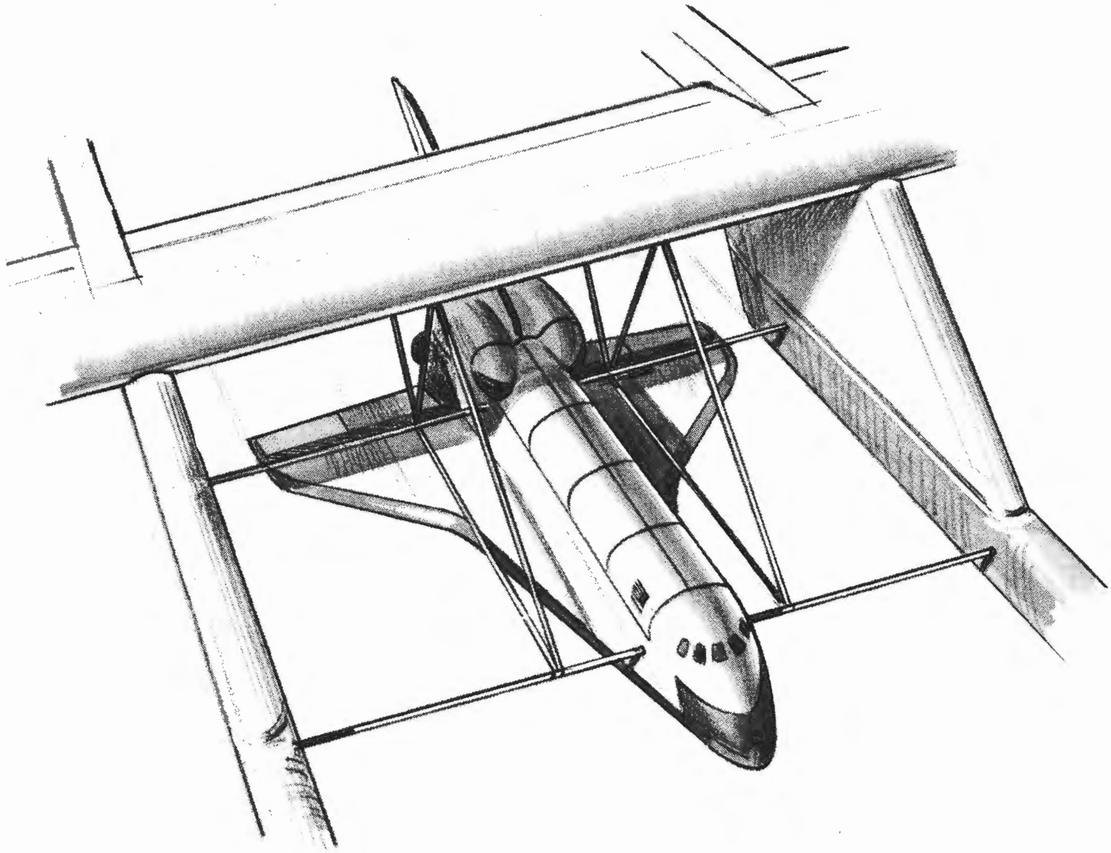
The primary area in which government furnished equipment (GFE) might be of benefit to the program would be in the area of ground and flight test equipment and instrumentation. This would include shaking and vibration equipment and telemetering instrumentation for the flight test program. There is also the possibility, depending upon how the aircraft would be built and financed, of using GFE power plants. We are also assuming that the government would wish to furnish the fuel for the aircraft operations.

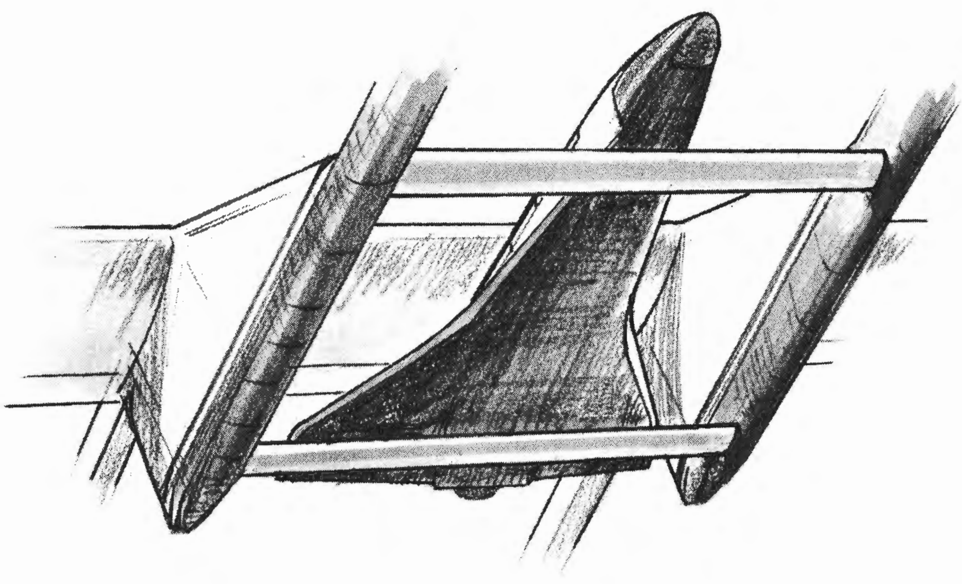
EQUIPMENT OR STRUCTURE REQUIRED TO CARRY THE ORBITER, EXTERNAL TANK OR SOLID ROCKET BOOSTER COMPONENTS

In preliminary discussions with Rockwell International Space Division personnel, we determined that perhaps the best method of holding the Orbiter for air drop missions, would be at the four lifting hard points located on the sides of the Orbiter fuselage. The use of these hard points, even though additional beef-up might be required at these locations in order to sustain flight loads, would minimize engineering and manufacturing requirements for the Orbiter manufacturer. The Orbiter would be separated from the holding structure by some method, which has been proven to be successful through actual flight experience, such as that used on the X-15. A second concept could be designed for the transportation phase of the program as compared to the drop missions. This concept would be two large trusses, designed with an aerodynamic exterior configuration, extending between the B-52 fuselages. The Orbiter could be positioned under the Virtus and these trusses would be raised into a position for attachment to the Orbiter external tank hard points and then raised for attachment to the B-52 fuselages. This would enable the transportation to be accomplished without additional beef-up to the Orbiter lifting points. The Orbiter to be used for the approach and landing tests, upon completion of those tests could have removed, during refurbishing, any additional scar weight caused by the lifting point beef-up.

The following page provides artist's sketches of these two concepts.

The cargo pod, shown in the artist's painting in the front of this presentation, would be designed to accommodate the external fuel tank, solid rocket booster components, and other outsize cargo. Following in this section is a drawing showing approximate dimensions of the pod.

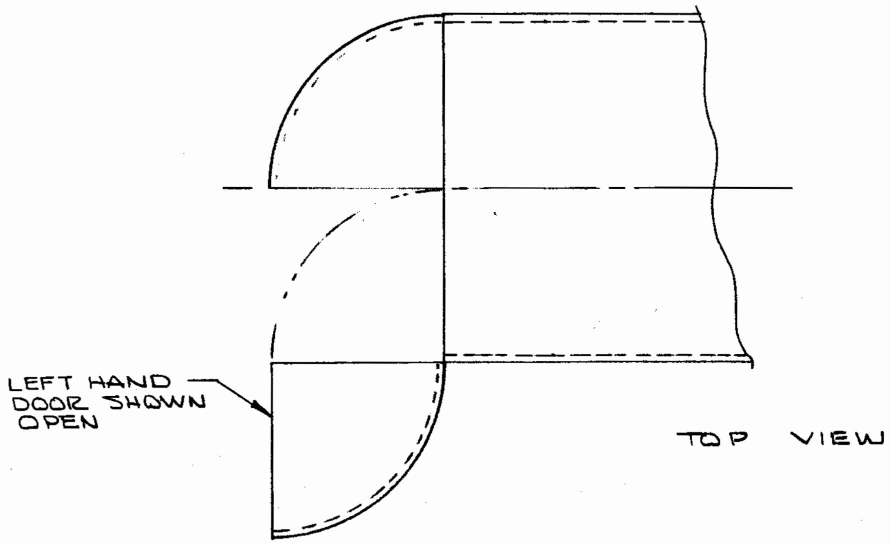




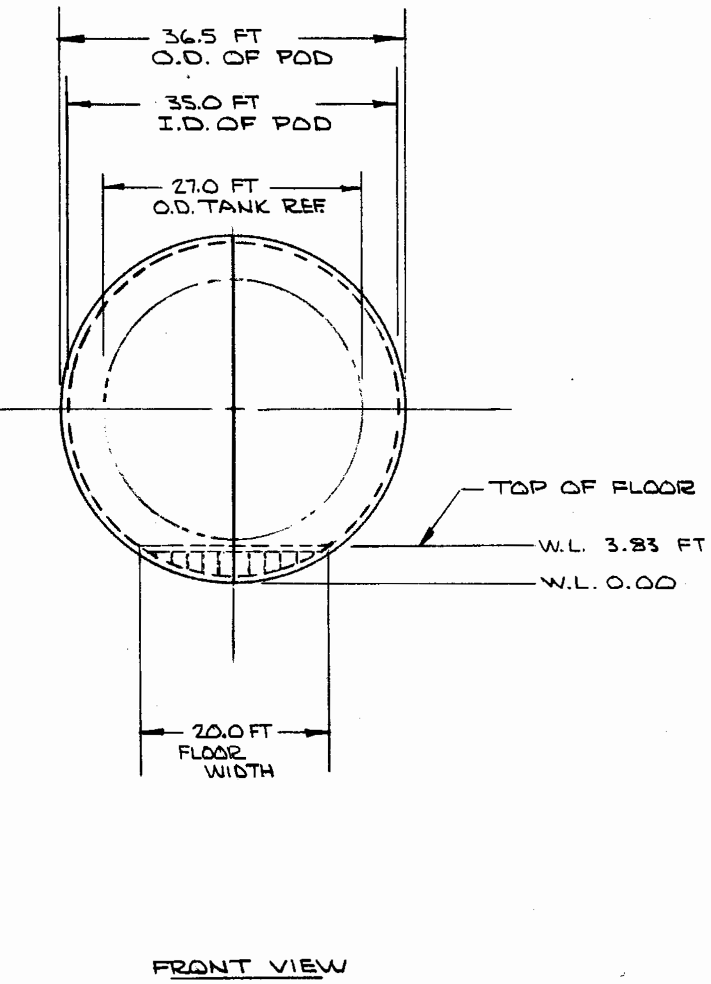
ORBITER HOLDING FIXTURES FOR AIR DROPPING AND TRANSPORTATION MODES

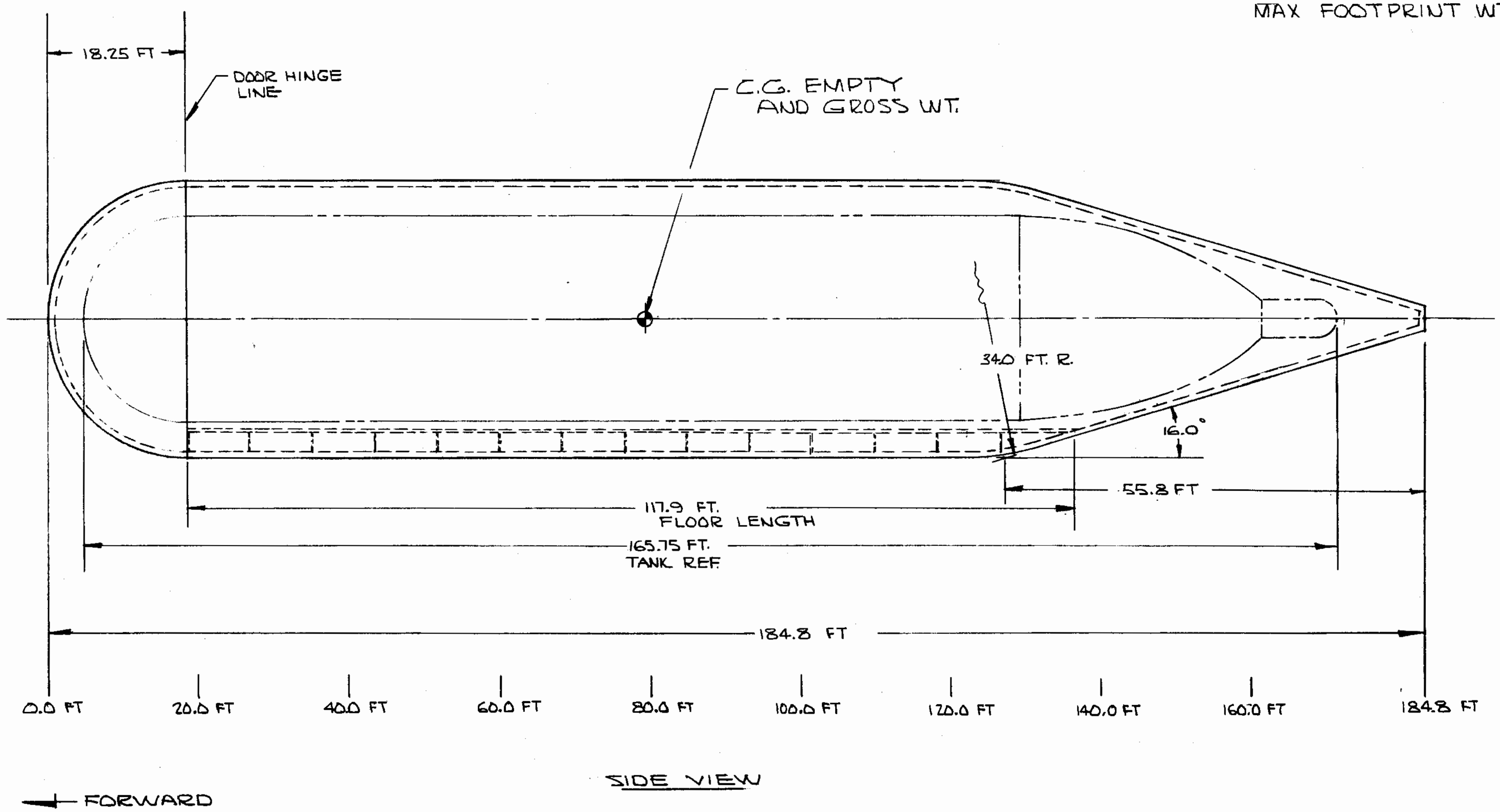
The top sketch depicts a concept for structure, which would be designed for air dropping the Orbiter.

The lower sketch portrays the Orbiter in a transportation configuration, mounted atop two struts and secured by the external tank attach hardware.



POD EMPTY WT _ _ _ _ _ 60,000 LBS
POD CARGO CAP _ _ _ _ _ 315,000 LBS
MAX FOOTPRINT WT _ _ _ _ _ _ _ 300 PSF





COST AND SCHEDULES REQUIRED FOR DEVELOPMENT, TEST, AND PRODUCTION

The following pages contain estimated cost breakdowns for the development, production, and testing of two Virtus aircraft. These cost estimates were developed by dividing the aircraft into segments, as shown by the exploded view on the following page. We then estimated the cost of construction of each of these segments by man-hours, material, and weight. In addition, we have estimated the cost of facilities, tooling, fixtures, etc. The final figure includes the assembly of the Virtus segments and ground and flight testing. Our estimated cost for two aircraft totals $31,995,000. To this, we would add $3,005,000 to cover contingencies and items which may have been overlooked in this brief study. This brings our total estimated cost for two aircraft to $35,000,000. It should be noted that this figure does not consider profit, nor does it include power plants, as these may be government furnished equipment (C-5A units), or leased power packages.

We have met with Pratt & Whitney personnel and they have advised that they would be pleased to enter into a lease or lease-purchase agreement, wherein they would furnish us with complete JT9D engine power packages. This arrangement would provide us with JT9D-7 engines, having a take-off thrust rating of 45,500 pounds, which is approximately fourteen percent higher thrust than that used in our aerodynamic performance estimates. This lease arrangement would also include complete support in the form of any parts or maintenance required on the engines, exclusive of routine operational maintenance. They would supply our maintenance facility with those spares which they felt necessary to provide this support.

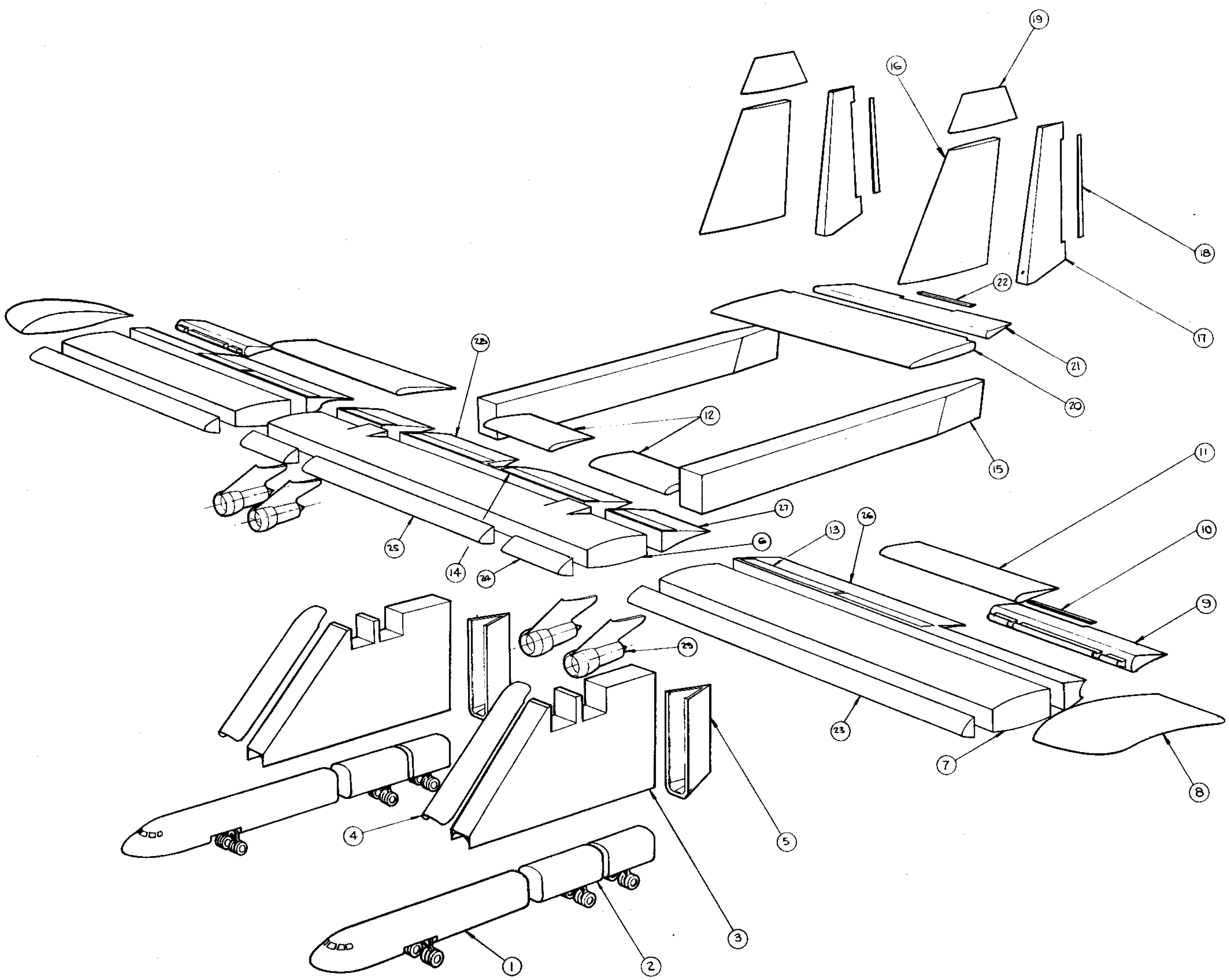
We realize that these cost estimates will appear to be unreasonably low to most, however, our experience over the past twelve years, commencing with the construction of the Pregnant Guppy, has enabled us to develop a prototype manufacturing approach, which allows us to keep our man-hours and costs at a fraction of those of major aerospace manufacturers.

Cost estimates were prepared by Messrs. R. W. Lillibridge and H. L. Gallaher. Mr. Lillibridge was in charge of engineering and manufacturing of the Pregnant Guppy, Super Guppy, Mini Guppy, Commercial Super Guppies and our outsized version of the Canadair CL-44. During the same period of time, he was also in charge of turbo-prop conversion of three piston-powered aircraft. With the exception of the Super Guppy and two of the turbo-prop conversions, these were all F.A.A. certificated aircraft. Mr. Gallaher, for many years, was in charge of aircraft modification and overhaul for On Mark Engineering, Pacific Airmotive Corporation and, more recently, with American Jet Industries. These two men, with a combined total of more than sixty years in the industry, in our opinion probably have as much expertise in the areas necessary for performing time and cost estimates for this type of program, as any two experts that could be found in this country. In the preparation of these estimates, realizing they might have to live with their numbers, we believe, if anything, these gentlemen have leaned slightly toward the conservative side.

Following the cost break-down is an engineering and production schedule. As with our cost estimate, we are certain that many people will consider this schedule to be impossible. About all we can say in attempting to support the credibility of our estimates is that we, the same people who have prepared this study, were told that our Guppy scheduling estimates were also impossible. We would like to remind those who doubt that we could have an aircraft operational by the first of 1977, that we constructed and flew the Super Guppy in *eight months* and the MiniGuppy in *five and one half months.* This included engineering time and was without the benefit of outside sub-contracting of manufacturing, as we propose for the Virtus. We estimate a total of 27 months from go-ahead to acceptance for operations for the first aircraft. If we were to go ahead by 1 June 1974, we would have the luxury of 4 months cushion in order to meet a target date of 1 January 1977.

ESTIMATED DOLLARS REQUIRED FOR FACILITY AND OTHER COSTS
OTHER THAN PRODUCTION AND PRODUCTION SUPPORT
WHICH ARE INCLUDED IN
BASIC LABOR RATE

ENGINEERING	147,000 hours @ $17.00 per hour	$2,500,000
ENGINEERING SYSTEMS	Outside purchase, including hardware	500,000
PROCURE B-52's AND TRANSPORTATION	6 each @ $10,000 plus disassembly and transportation @ $20,000	180,000
FACILITY LEASE	36 months @ $34,750 per month	1,250,000
SCAFFOLDING AND SPECIAL HANDLING EQUIPMENT	Scaffolding, cradles, slings, rollers, dollies, etc.	1,000,000
STANDARD TOOLS AND EQUIPMENT	Shears, breaks, drill presses, tool crib, trucks, compressors, etc.	500,000
SPECIAL EQUIPMENT	Spot welders, forming rolls, presses, etc.	200,000
JIGS AND FIXTURES	Drill fixtures, welding and assembly fixtures	500,000
TEST PROGRAM	100 hours @ $2,000 per hour plus $50,000 instrumentation	250,000
INSURANCE	2% of $20,000,000	400,000
	TOTAL FOR FACILITIES AND OTHER	$7,280,000



29 ENGINES & PYLONS PRATT & WHITNEY JT 9D-3A TURBOFAN
28 WING TRAILING EDGE CENTER SECTION
27 WING TRAILING EDGE CENTER SECTION LEFT & RIGHT HAND SIDE
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2 B-52 LANDING GEAR SECTION MODIFIED LEFT & RIGHT HAND SIDE
1 B-52 FWD FUSELAGE MODIFIED LEFT & RIGHT HAND SIDE

FACILITIES AND OTHER,
LABOR, AND MATERIAL
(By Aircraft)

Item No.	Description	Weight	X	Cost Per Pound	First Aircraft	Second Aircraft
3	Pylon Superstructure	33,400	@	$67.73	$ 2,262,182	
			@	61.28		$ 2,046,752
4	Pylon Forward Fairing	1,400	@	67.73	94,822	
			@	61.28		85,792
5	Pylon Rear Fairing	2,400	@	67.73	162,552	
			@	61.28		147,072
6	Wing, Center Section	44,700	@	67.73	3,027,531	
			@	61.28		2,739,216
7	Wing, Outer Panel	78,000	@	67.73	5,282,940	
			@	61.28		4,779,840
8	Wing, Tip	5,000	@	67.73	338,650	
			@	61.28		306,400
9	Aileron	1,760	@	67.73	119,204	
			@	61.28		107,852
10	Aileron Tab	200	@	67.73	13,546	
			@	61.28		12,256
11	Wing Flap, Outboard	2,400	@	67.73	162,552	
			@	61.28		147,072
12	Wing Flap, Center	1,200	@	67.73	81,276	
			@	61.28		73,536
13	Wing Spoilers, Outboard	1,200	@	67.73	81,276	
			@	61.28		73,536
14	Wing Spoilers, Center	1,000	@	67.73	67,730	
			@	61.28		61,280
15	Boom	34,800	@	67.73	2,357,004	
			@	61.28		2,132,544
16	Vertical Stablilizer	9,160	@	67.73	620,406	
			@	61.28		561,324
17	Rudder	1,800	@	67.73	121,914	
			@	61.28		110,304

FACILITIES AND OTHER, LABOR, AND MATERIAL (cont'd)

Item No.	Description	Weight	X	Cost Per Pound	First Aircraft	Second Aircraft
18	Rudder Tab	200	@	$67.73	$ 13,546	
			@	61.28		$ 12,256
19	Vertical Stabilizer Tip	500	@	67.73	33,865	
			@	61.28		30,640
20	Horizontal Stabilizer	15,000	@	67.73	1,015,950	
			@	61.28		919,200
21	Elevator	1,010	@	67.73	68,407	
			@	61.28		61,892
22	Elevator Trim Tab	150	@	67.73	10,159	
			@	61.28		9,192
23	Wing, Leading Edge, Outboard	1,400	@	67.73	94,822	
			@	61.28		85,792
24	Wing, Leading Edge, L/R, Center	800	@	67.73	54,184	
			@	61.28		49,024
25	Wing, Leading Edge, Center	800	@	67.73	54,184	
			@	61.28		49,024
26	Wing, Trailing Edge, Outboard	2,600	@	67.73	176,098	
			@	61.28		159,328
27	Wing, Trailing Edge, Center, L/R	1,600	@	67.73	108,368	
			@	61.28		98,048
28	Wing, Trailing Edge, Center	1,600	@	67.73	108,368	
			@	61.28		98,048
29	Pylon, Engine	4,000	@	67.73	270,920	
				61.28		245,120

MATERIAL COST
(Analysis by Weight - 1 Aircraft)

Aircraft Empty Weight		362,000 lbs.	
Item 1:			
B-52 fuselages and gear 2 each @ 23,300 lbs.	46,600 lbs.		
Item 2:			
B-52 landing gear 4 each @ 7,800 lbs.	31,200 lbs.		
Item 29:			
Engines 4 each @ 9,000 lbs.	36,000 lbs.		
		-113,800 lbs.	
NEW MANUFACTURED WEIGHT		248,200 lbs.	
Weight Distribution			
Basic structure - 67% =		166,000 lbs.	
Surfaces and systems - 33% =		82,000 lbs.	
166,000 lbs. @ $5.00 per lb.			$ 830,000
82,000 lbs. @ $20.00 per lb.			1,640,000
MATERIAL COST - PER AIRCRAFT			$2,470,000

MATERIAL FOR ONE AIRCRAFT

Item No.	Description	Weight and Cost	Weight and Cost	Cost Per Item
3	Pylon Superstructure	22,200 @ $5.00		$ 111,000
			11,100 @ $20.00	222,000
4	Pylon Forward Fairing	1,400 @ $5.00		7,000
5	Pylon Rear Fairing	2,400 @ $5.00		12,000
6	Wing, Center Section	29,800 @ $5.00		149,000
			14,900 @ $20.00	298,000
7	Wing, Outer Panel	52,000 @ $5.00		260,000
			26,000 @ $20.00	520,000
8	Wing, Tip	5,000 @ $5.00		25,000
9	Aileron	1,172 @ $5.00		5,860
			586 @ $20.00	11,720
10	Aileron Tab	132 @ $5.00		660
			66 @ $20.00	1,320
11	Wing Flap, Outboard	1,600 @ $5.00		8,000
			800 @ $20.00	16,000
12	Wing Flap, Center	800 @ $5.00		4,000
			400 @ $20.00	8,000
13	Wing Spoilers, Outboard	800 @ $5.00		4,000
			400 @ $20.00	8,000
14	Wing Spoilers, Center	666 @ $5.00		3,330
			333 @ $20.00	6,660
15	Boom	23,200 @ $5.00		116,000
			11,600 @ $20.00	232,000
16	Vertical Stabilizer	6,106 @ $5.00		30,530
			3,053 @ $20.00	61,060
17	Rudder	1,200 @ $5.00		6,000
			600 @ $20.00	12,000
18	Rudder Tab	132 @ $5.00		660
			66 @ $20.00	1,320
19	Vertical Stabilizer Tip	332 @ $5.00		1,660
			166 @ $20.00	3,320
20	Horizontal Stabilizer	10,000 @ $5.00		50,000
			5,000 @ $20.00	100,000

MATERIAL FOR ONE AIRCRAFT (cont'd)

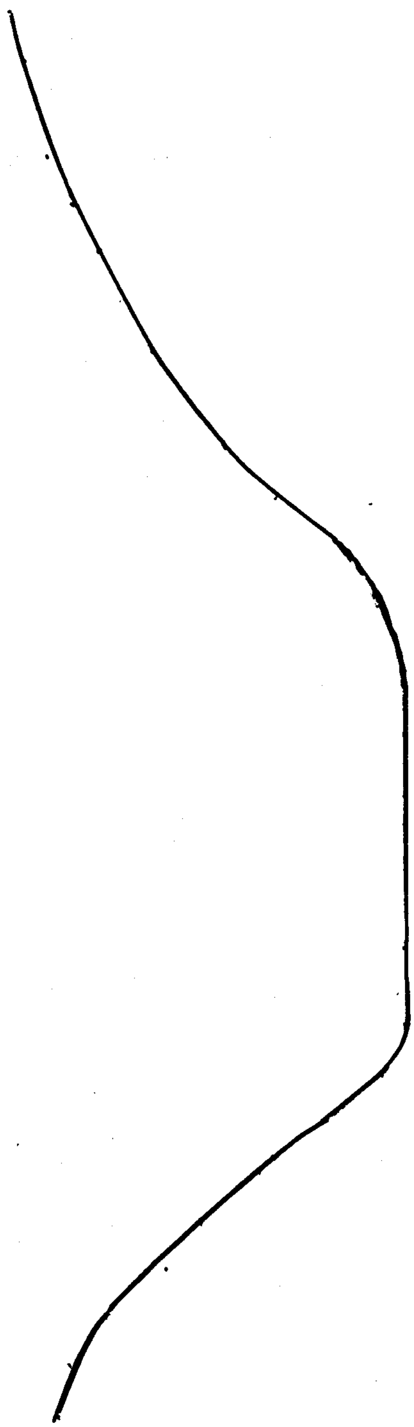
Item No.	Description	Weight and Cost	Weight and Cost	Cost Per Item
21	Elevator	672 @ $5.00		$ 3,360
			336 @ $20.00	6,720
22	Elevator Tab	100 @ $5.00		500
			50 @ $20.00	1,000
23	Wing, Leading Edge, Outboard	932 @ $5.00		4,660
			466 @ $20.00	9,320
24	Wing, Leading Edge, L/R, Center	532 @ $5.00		2,660
			266 @ $20.00	5,320
25	Wing, Leading Edge, Center	532 @ $5.00		2,660
			266 @ $20.00	5,320
26	Wing, Trailing Edge, Outboard	1,732 @ $5.00		8,660
			866 @ $20.00	17,320
27	Wing, Trailing Edge, Center, L/R	1,066 @ $5.00		5,330
			533 @ $20.00	10,660
28	Wing, Trailing Edge, Center	1,066 @ $5.00		5,330
			533 @ $20.00	10,660
29	Pylon, Engine	2,666 @ $5.00		13,330
			1,333 @ $20.00	26,660
		TOTAL MATERIAL COST		$2,435,570

MAN-LOAD - IN-HOUSE LABOR - 30 MONTHS

FIRST AIRCRAFT

	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEP	OCT	NOV	DEC
1974							15	20	25	30	40	50
1975	60	75	90	105	125	150	165	175	180	180	180	180
1976	180	180	180	180	170	155	130	105	80	55	40	35

Mo. No.	No. Men
1	15
2	20
3	25
4	30
5	40
6	50
7	60
8	75
9	90
10	105
11	125
12	150
13	165
14	175
15	180
16	180
17	180
18	180
19	180
20	180
21	180
22	180
23	170
24	155
25	130
26	105
27	80
28	55
29	40
30	35



FIRST AIRCRAFT

In-House labor

Total man months - 3,335

1 man month = 180 hours

Total man-hours - 600,000

SECOND AIRCRAFT

Man-hours 400,000

TOTAL IN-HOUSE LABOR 1,000,000 hours

PRODUCTION COSTS

IN-HOUSE LABOR (By Man-hour)

First Aircraft	
3,335 man-months = 600,000 hours @ $10.00 per hour	$ 6,000,000
Second Aircraft	
2,222 man-months = 400,000 hours @ $11.00 per hour	4,400,000
TOTAL IN-HOUSE LABOR COST	$10,400,000

SUB-CONTRACTOR LABOR (By Man-hour - 2 Aircraft)

Contractors' Labor (percentage of total - 43%)	
43% of 1,750,000 = 750,000 hours @ $12.50 per hour	$ 9,375,000

PER AIRCRAFT = $4,687,500

TOTAL LABOR COST - First Aircraft	$10,687,500
TOTAL LABOR COST - Second Aircraft	9,087,500
TOTAL - 2 AIRCRAFT	$19,775,000

TOTAL COST
PER
MANUFACTURED POUND
(By Aircraft)

FIRST AIRCRAFT

Facilities and other (1/2)	$ 3,640,000
Material	2,470,000
In-House labor	6,000,000
Sub-Contractor labor	4,687,500
TOTAL	$16,797,500

Weight - New manufacture = 248,000 lbs.

Per pound cost - First Aircraft = $67.73

SECOND AIRCRAFT

Facilities and other (1/2)	$ 3,640,000
Material	2,470,000
In-House labor	4,400,000
Sub-Contractor labor	4,687,500
TOTAL	$15,197,500

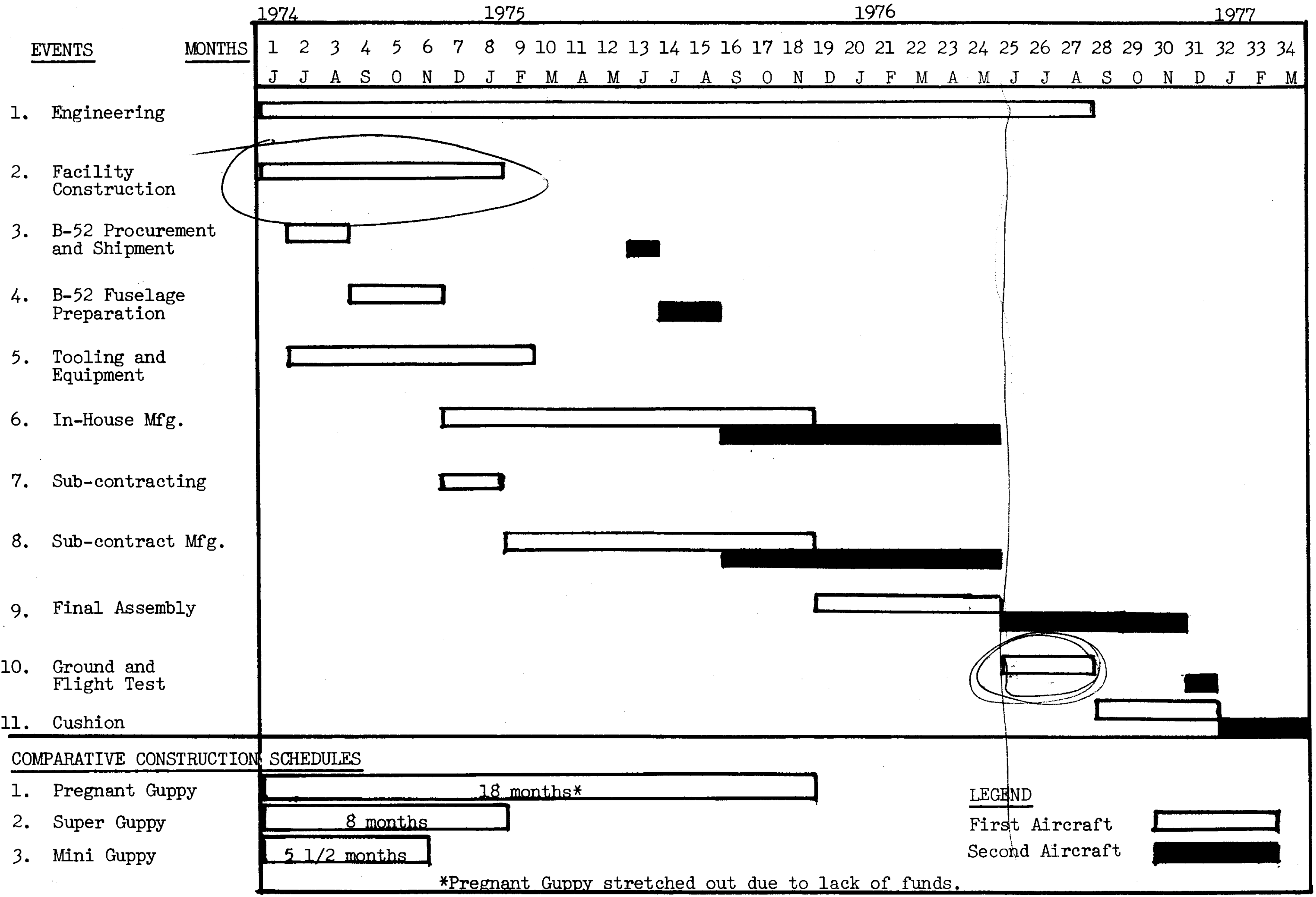
Weight - New manufacture = 248,000 lbs.

Per pound cost - Second Aircraft = $61.28

SUMMARY

Facilities and Other Items	$7,280,000
Total Material (2 aircraft @ $2,470,000)	4,940,000
In-House Labor - First Aircraft	6,000,000
In-House Labor - Second Aircraft	4,400,000
Sub-Contractor Labor (2 aircraft @ $4,687,500)	9,375,000
TOTAL PROJECTED COST	$31,995,000

"VIRTUS" CONSTRUCTION SCHEDULE



OPERATION AND ESTIMATED OPERATING COST

The operation of the aircraft, whether or not it has received F.A.A. certification, would be conducted under the regulations governing large aircraft, commercial operations. The operation would be under the surveillance of F.A.A. Air Carrier Operations and Maintenance Personnel. This is similar to the procedure followed in the operation of the Super Guppy, which while not a certificated aircraft, was constantly monitored by the F.A.A.

The aircraft operations would be scheduled and controlled by NASA Headquarters or a designated center.

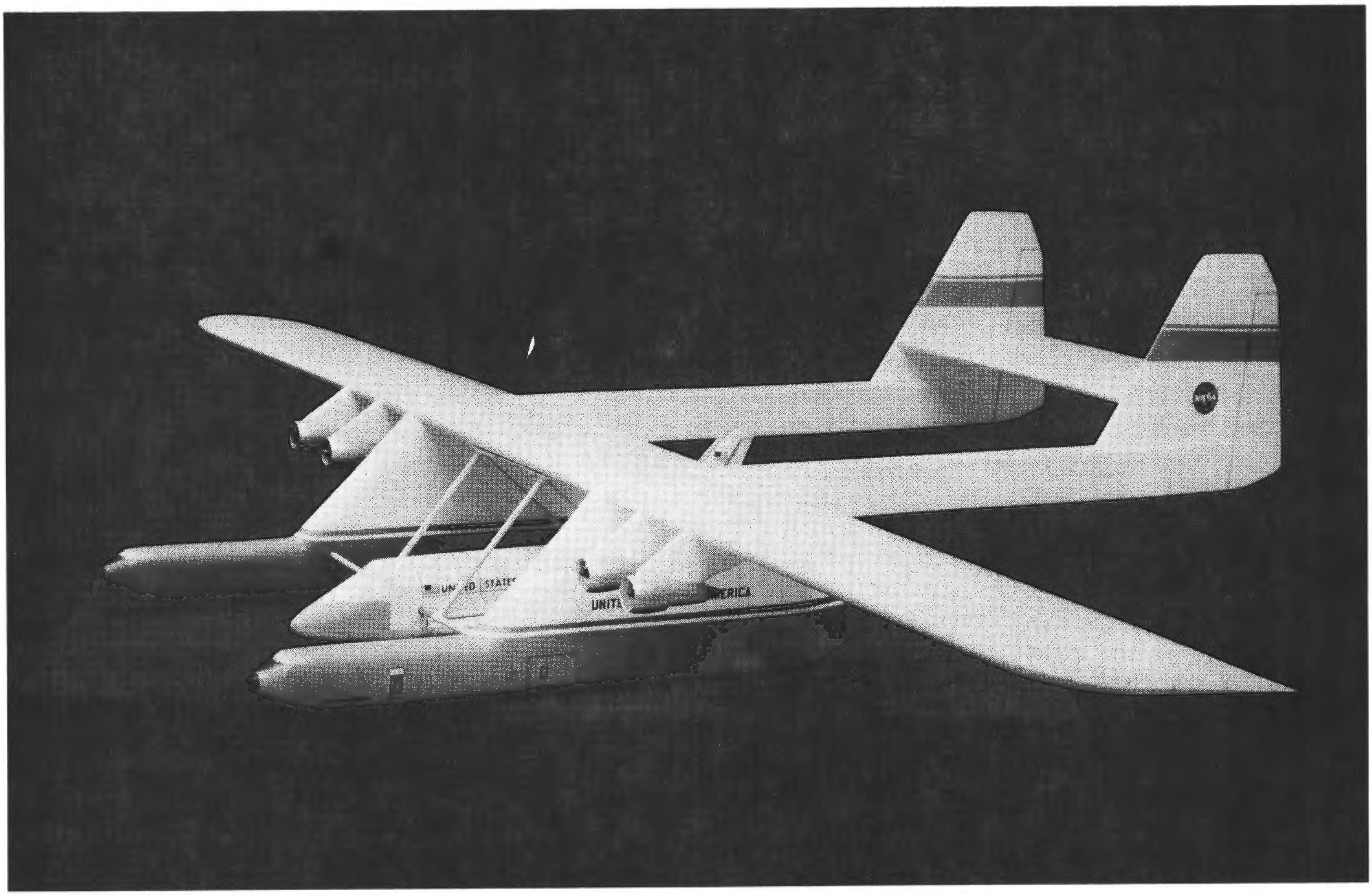
We estimate the operating cost of the aircraft would be approximately $1,000 per hour plus fuel, and not considering depreciation. With an estimated block speed of 275 miles per hour this comes to $3.63 per mile, plus approximately 4,000 gallons of jet fuel per flight hour.

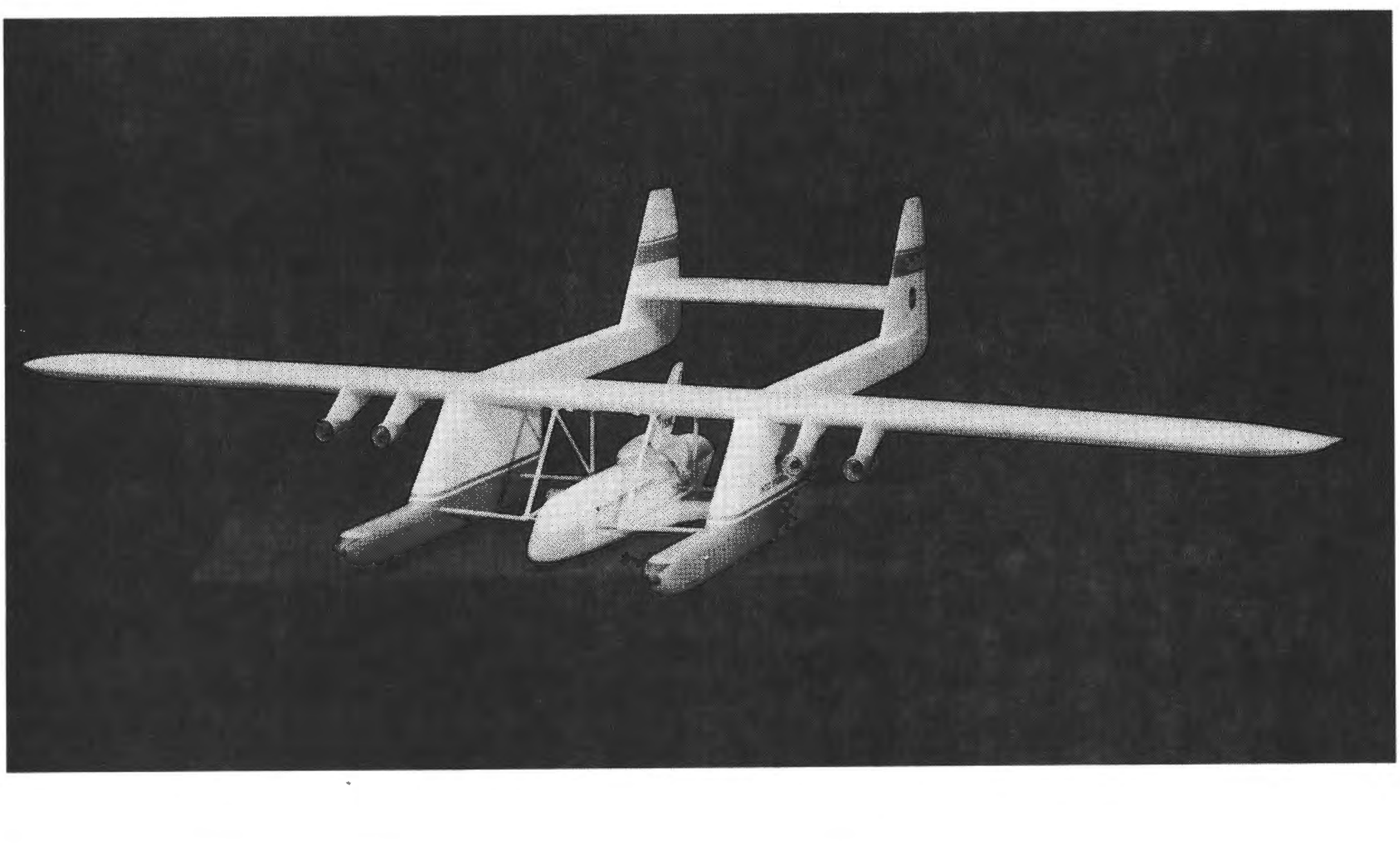
CONCLUSION

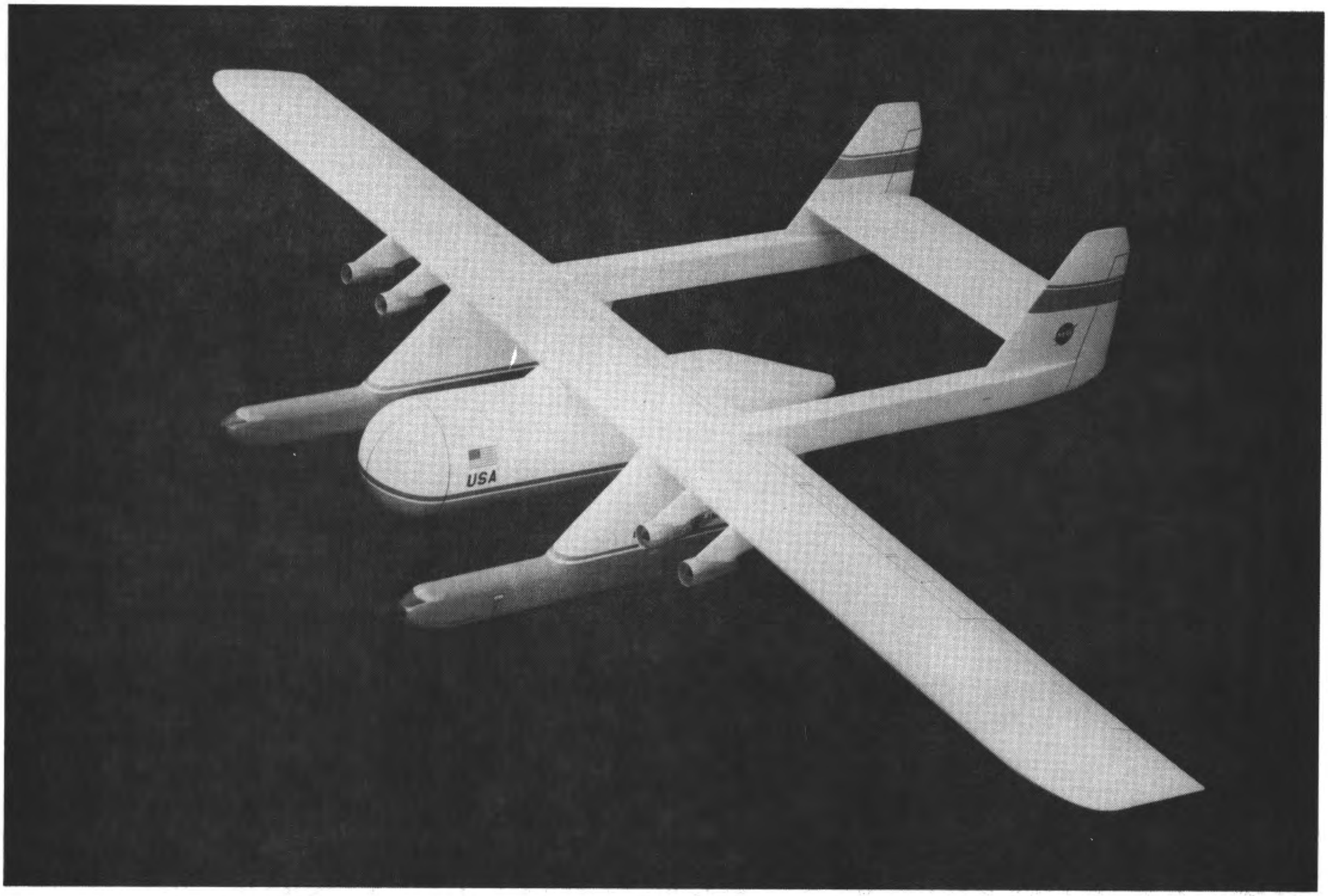
The results of this study and that performed by Langley Research Center, we feel provide conclusive evidence as to the technical feasibility of the Virtus. This applies, not only for the air drop and transportation of the Orbiter, but also for the transportation of the external fuel tank and solid rocket booster cases and segments. The aircraft will also provide airlift capabilities for other NASA and Department of Defense outsize items heretofore beyond the hopes of traffic specialists.

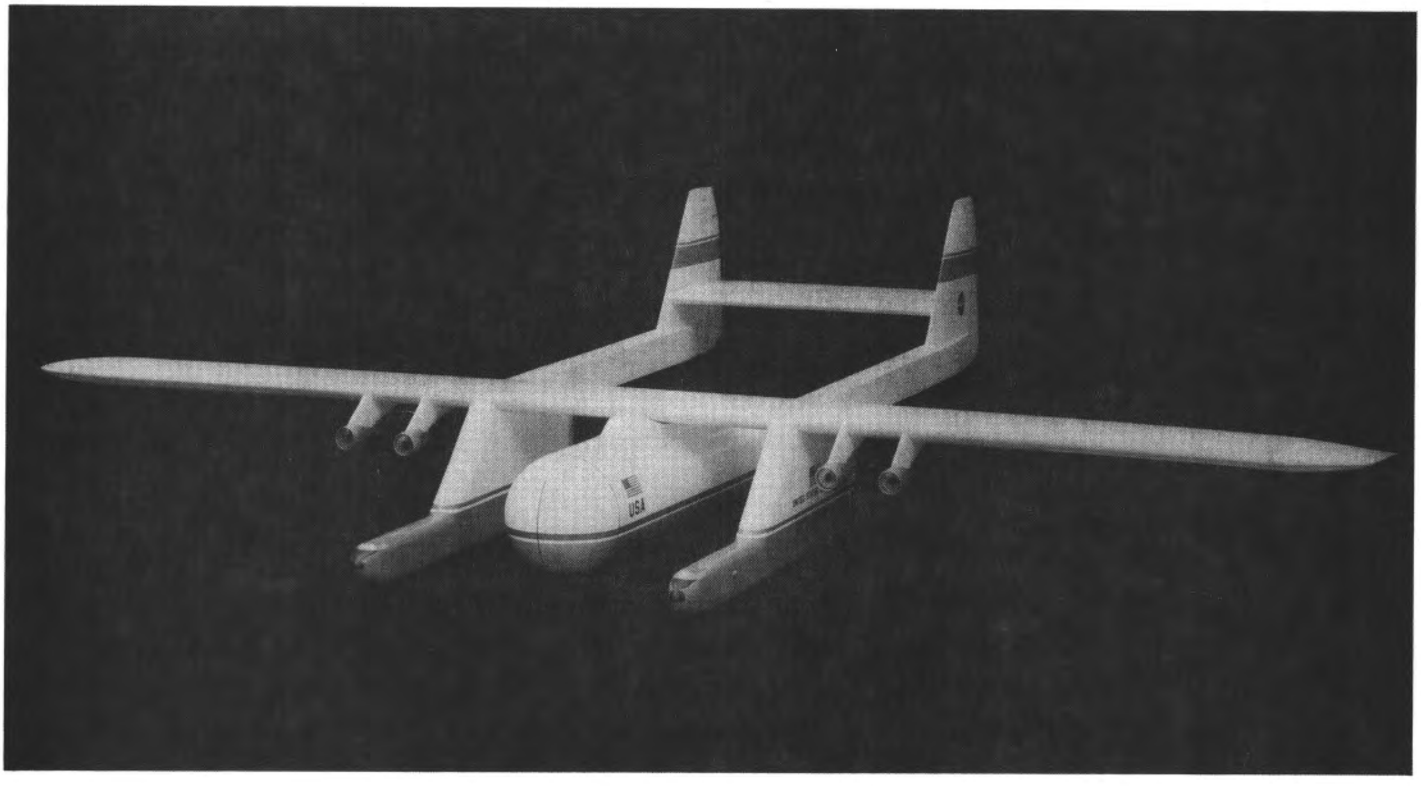
We are fully cognizant that the primary questions that will arise in the minds of interested parties are, "Can they do this for the price they are quoting?", and "Can they do this within the time frame necessary to do the job?". Naturally, we believe that we can and all that we can do is point to past accomplishments. It should be perfectly obvious, however, that the earlier we get started the greater our chances for success.

We have constructed a one percent scale model of the Virtus (see photos following). This was not a part of our contract, but we wanted interested parties to be able to make a physical comparison of our model along side the same scale models of the B-747 and the C-5A. We believe that when this comparison is made, the sensible selection of the aircraft to perform the Space Shuttle System Transportation will be obvious.






USA


USA

The following pages are reprints of various media articles providing background information on the past accomplishments of the Guppy manufacturing team and its capabilities.

083-7 VOL. 10, NO. 4 APRIL/1974 PDC $1.25

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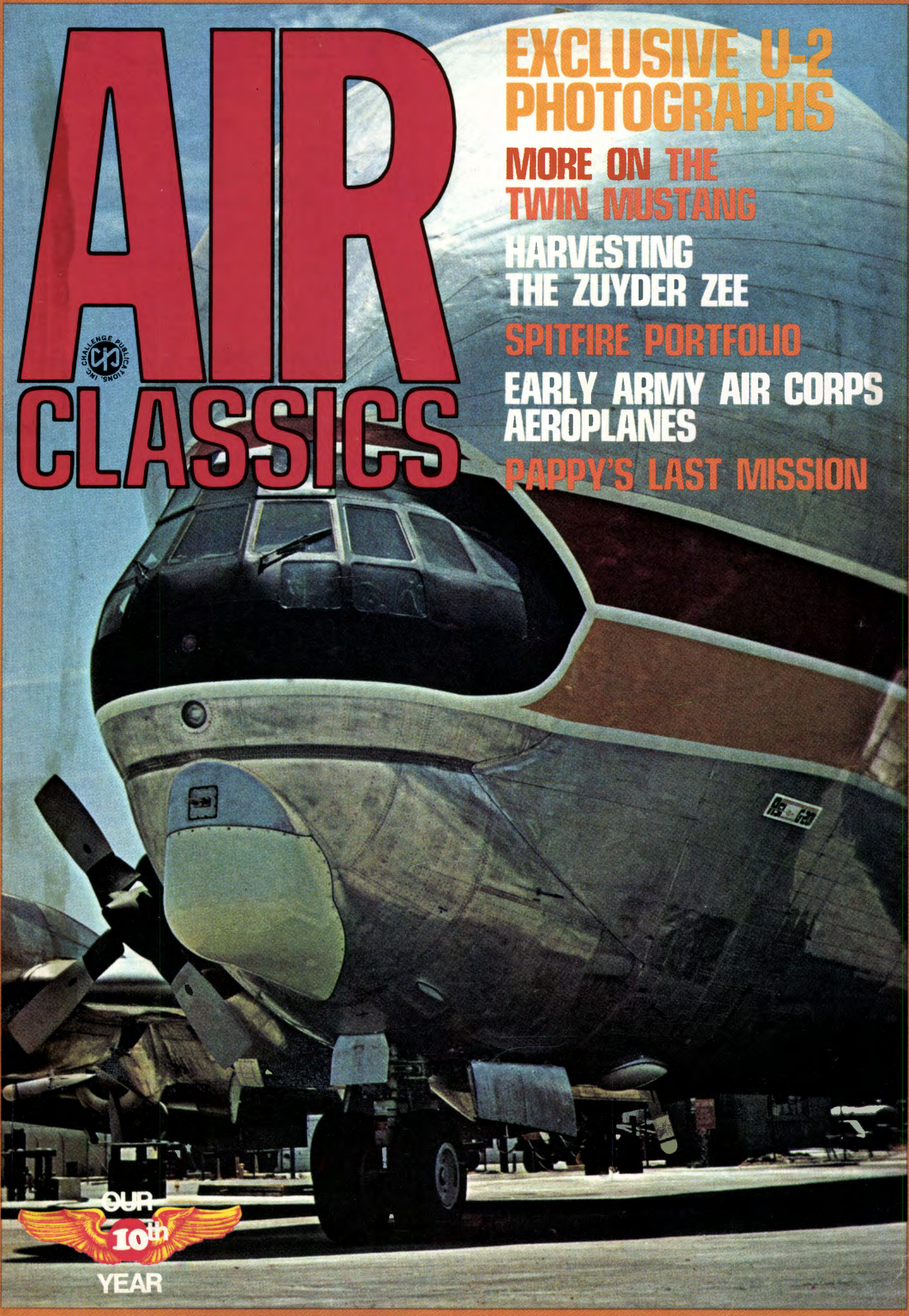
PAPPY'S LAST MISSION




Ae

Although the rotund shape of the Guppy transports is known around the world, the entire fleet amounted to only six aircraft and their flying days may be over.

THE GUPPY FAMILY

by Owen Gault

A SWOLLEN SHAPE passed through the last vestiges of the Southern California smog belt and the sun glinted sullenly off its silver sides. Its deep-throated roar rumbled heavily and to the casual observer who happened to glance upward, a cloud of silver aluminum was majestically boring its way through the haze. This was the Pregnant Guppy, a super-modified Boeing 377 Stratocruiser that was literally built in a backyard.

The backyard in this instance was the area behind the On Mark hangar at Van Nuys Airport. The time was the early 1960s, and the modified Boeing was the brainchild of one Jack Conroy.

The idea of an outsized transport to carry an outsized cargo had long been a popular one with Conroy. He was also a contractor, non-sked airline pilot, and California Air National Guard pilot flying Boeing C-97Gs. The C-97 seemed to be an excellent vehicle for configuration to an oversized transport as it lent itself to stretching and swelling.

Unfortunately, Conroy had the idea but no money. He took the idea to Lee Mansdorf who owned a number of surplus 377s purchased from airlines when they were declared surplus after a short service life. Mansdorf probably would have had a hard time getting rid of his surplus white elephants on a market that was already becoming nearly all jet. Mansdorf agreed to provide Conroy with airframes but no financial support.

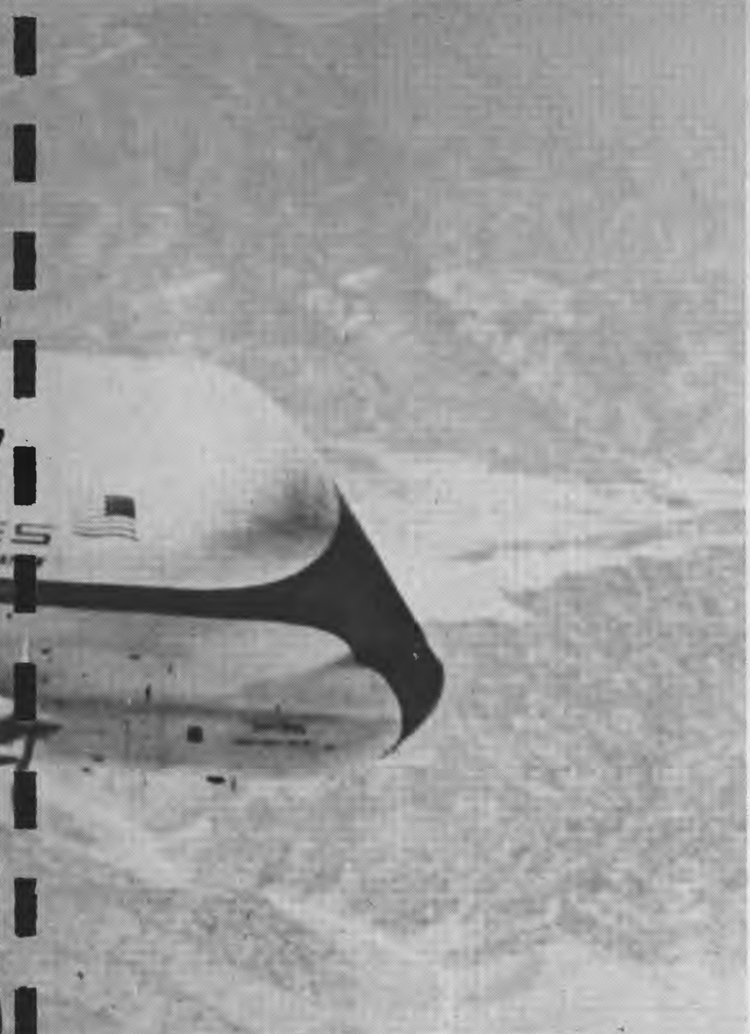
At this time NASA was taking a very active role in the space race. They were able to lob fairly large payloads into outer space but they were having one heck of a time moving the things that got the payloads up there. By this time Conroy had drawings made for

The first of a new breed leaves the ground at Van Nuys Airport on 19 September 1962. Jack Conroy's imagination outstripped even the wartime artists, who seemed to think that built-in swimming pools were essential features of all aircraft.

The Super Guppy, N1038V, formating with a Lear Jet over the San Fernando Valley. A different procedure was adopted in order to load cargo: in this instance the entire nose was swung aside, massive hinges being installed in the left side of the fuselage.

Looking a bit worn, 1038V squats on the ramp at Davis-Monthan AFB, outside of Tucson, Arizona. The plane had been flown over to transport preserved LTV A-7A Corsair IIs to the factory for complete overhaul and modification.

The "Pregnant Guppy," a standard Boeing 377 stretched and fitted with a new fuselage which more than doubled its original volume. The entire tail is unbolted and rolled away in order to load oversized cargo: the fuselage splits just aft of the wing trailing edge, the section visible as differently textured metal. The break runs through the "C" in the line name.



The second Aero Spacelines creation, called the "Super Guppy." This particular machine used the wings and engines from one of the YC-97Js based at Norton AFB near San Bernardino. The first flight of the Super Guppy took place on 31 August 1965.

his proposed transport, so he went off to Washington with high hopes. The NASA officials were skeptical but they did admit that such an airframe would be very useful if it did exist.

Conroy was more determined than ever to construct his behemoth and he hurried back to Van Nuys to sell everything that he had and borrowed everything he could to start construction. The final sum was not great but he formed Aero Spacelines and forged ahead. Due to lack of funds and the unavailability of a large enough hangar, Conroy opened his airplane "factory" in the warm California air behind the On Mark hangar.

At that time, On Mark was busy converting A-26s to executive configuration and the area was scattered with derelict military A-26s, shiny new A-26 transports, the occasional P-51D and B-17G, sections of Stratocruiser, and above all this, rising beneath a spider-web of scaffolding was the immense bulbous shape of a craft that was to become known as the "Pregnant Guppy."

The craft, much to the doubt of the FAA, winged into the air on 19 September 1962 and, to the relief of everyone, exhibited no bad flying characteristics despite the extra 5,000 pounds and huge size. The 377 fuselage was lengthened 16′ 8″ by splicing, just aft of the wing, a straight fuselage section from another derelict Stratocruiser. The swollen fuselage superstructure was then added, increasing the height by 20 feet.

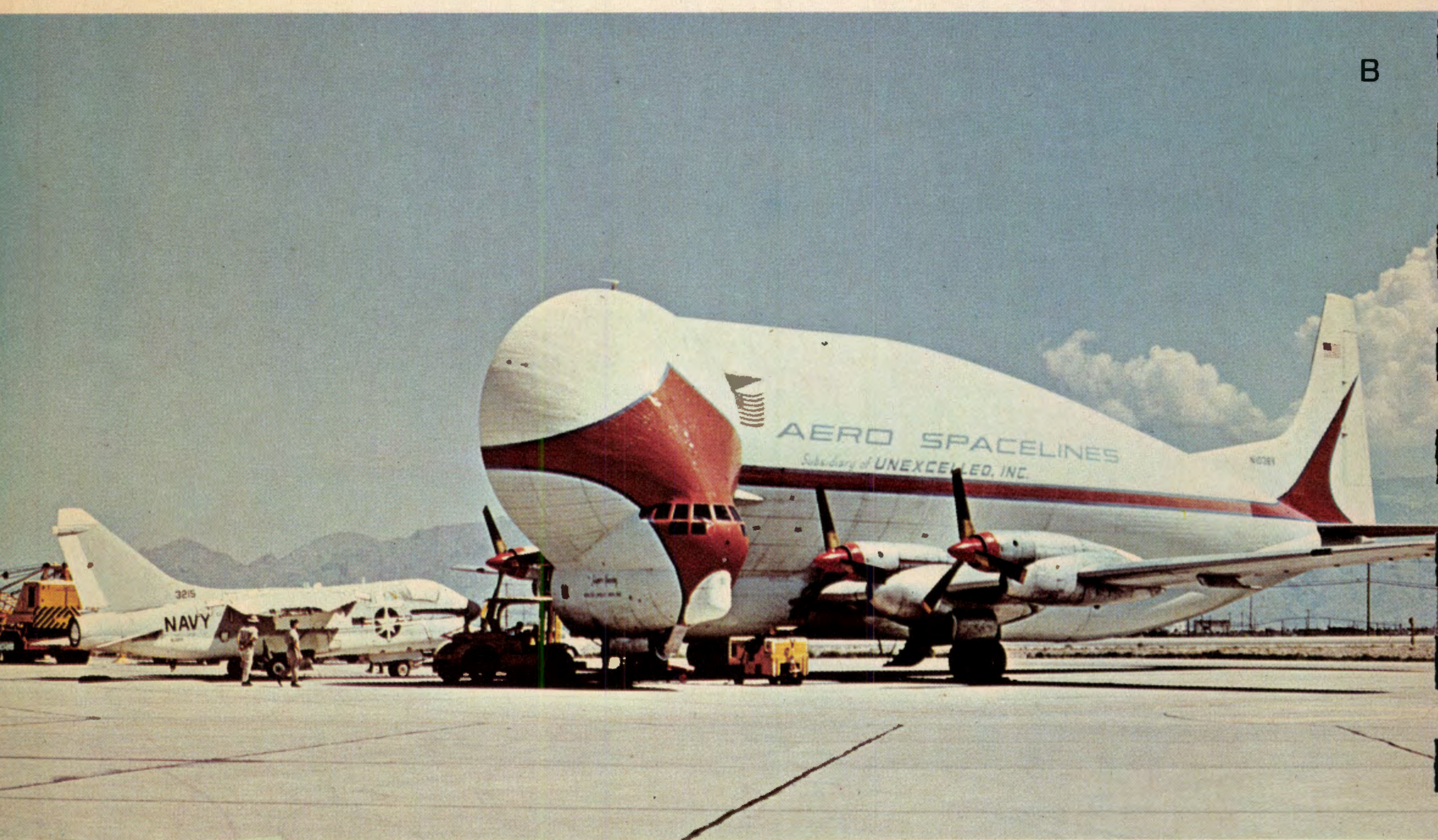
Loading was accomplished by another radical innovation; the entire fuselage aft of the wing was unbolted from the rest of the aircraft and rolled backward on a special carriage so that the cargo, usually a Saturn IV unit, could be loaded by a special elevating carriage.

In May 1963, a supplemental Type Certificate was issued under Part 8 of the Civil Air Regulations for a maximum payload of 34,000 pounds. In spite of the additional structure, empty weight increased to only 91,000 pounds. Cruising speed, not as important on this mission as on airline service, was reduced to 250 mph.

Conroy began to set his sights on large craft. A converted Saro Roe Princess and a sixteen engine B-52 conversion were planned, but in the end Conroy was back to the Stratocruiser. This time Conroy picked up one of the two YC-97Js. This craft was a turboprop

A

B

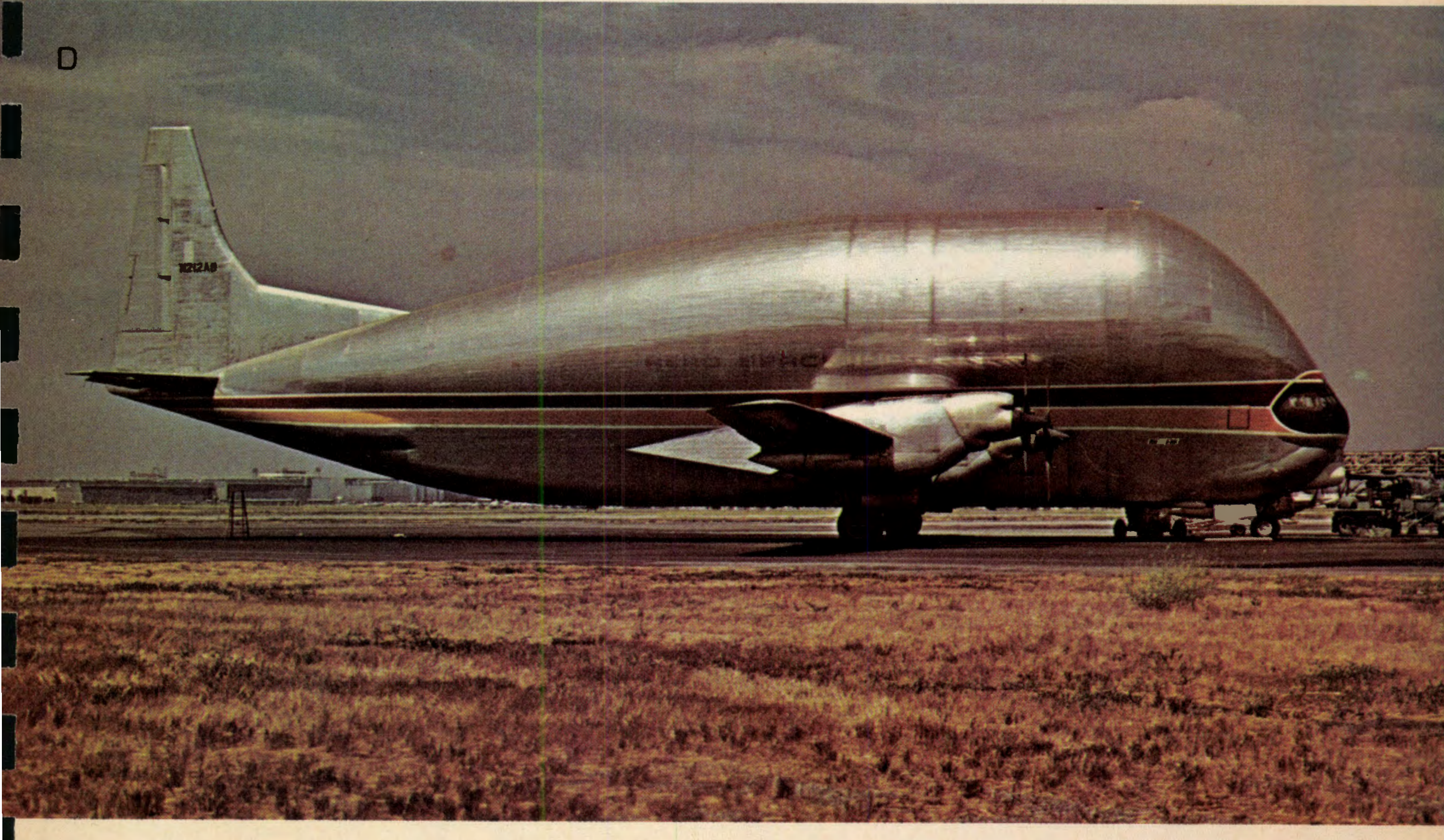


A) The first of the family, the Pregnant Guppy or Boeing 377PG, at Long Beach Airport. The PG proved that a standard transport could be swollen into a huge super transport. The PG helped carry much of the equipment that put a man on the moon. (R. Trimble)

B) The next offspring of the Guppy family was the Super Guppy, a turboprop powered version of the standard C-97. The SG is shown with its massive nose open and ready to receive an A-7 Corsair for transport to the factory for conversion and updating. The location is Davis-Monthan AFB in Arizona. (Mick Roth/ Centurion Enterprises)

C

D



C) Third heir to the throne was the Mini-Guppy. The MG was the smallest of the conversions and again utilized the basic 377 airframe. The second Mini-Guppy, a turboprop model, crashed at Edwards AFB while undergoing certification. (M. O'Leary)

D) The last of the line, the Aero Spacelines G-201A. This craft and another like it, were built for a French consortium. They are used to haul A.300 and Concorde parts from different subcontractors to the main factories. The G-201A is shown at Long Beach Airport prior to leaving for France. (M. O'Leary)

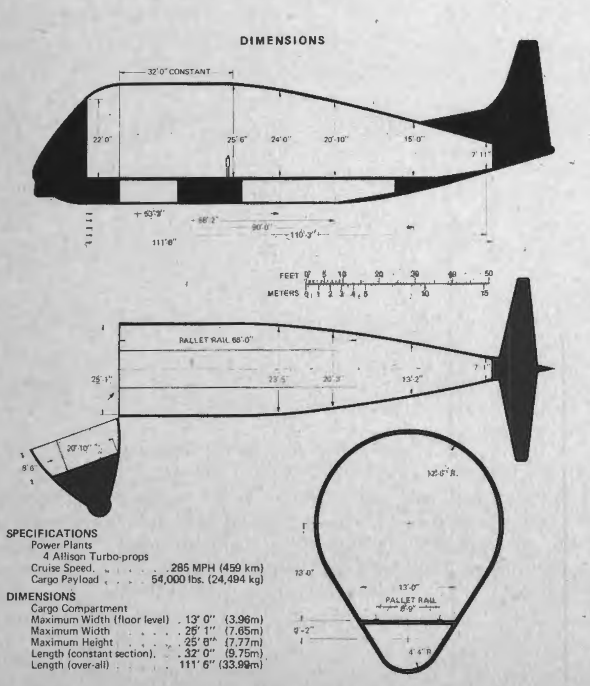
Basically a Mini-Guppy conversion, powered with T-56 turbine engines stripped from discarded Lockheed 188 Electras, the Guppy 101 crashed on a test flight at Edwards AFB, killing the flight crew and the new president of Aero Spacelines.

The Super Guppy on display at one of NAS Point Mugu's annual Space Fairs, with the nose partially swung open. The plane always attracts a large crowd, many of whom probably don't really believe what they see.

The first of the new type of Guppy, N1037V. Designated the Mini-Guppy, named "Spirit of Santa Barbara," the plane was flown to the Paris Air Show in 1968, where it excited considerable interest among aviation industrialists.

GUPPY-201

OUTSIZE-CARGO AIRLIFT

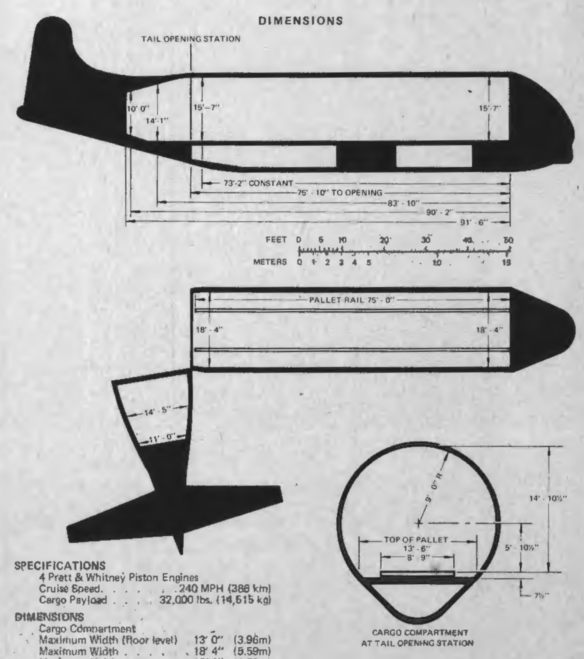


SPECIFICATIONS
Power Plants
4 Allison Turbo-props
Cruise Speed. . . . . . .285 MPH (459 km)
Cargo Payload . . . . 54,000 lbs. (24,494 kg)

DIMENSIONS
Cargo Compartment
Maximum Width (floor level) . 13' 0" (3.96m)
Maximum Width . . . . . . 25' 1" (7.65m)
Maximum Height . . . . . . 25' 8" (7.77m)
Length (constant section). . . 32' 0" (9.75m)
Length (over-all) . . . . . 111' 6" (33.99m)

MINI GUPPY

OUTSIZE-CARGO AIRLIFT

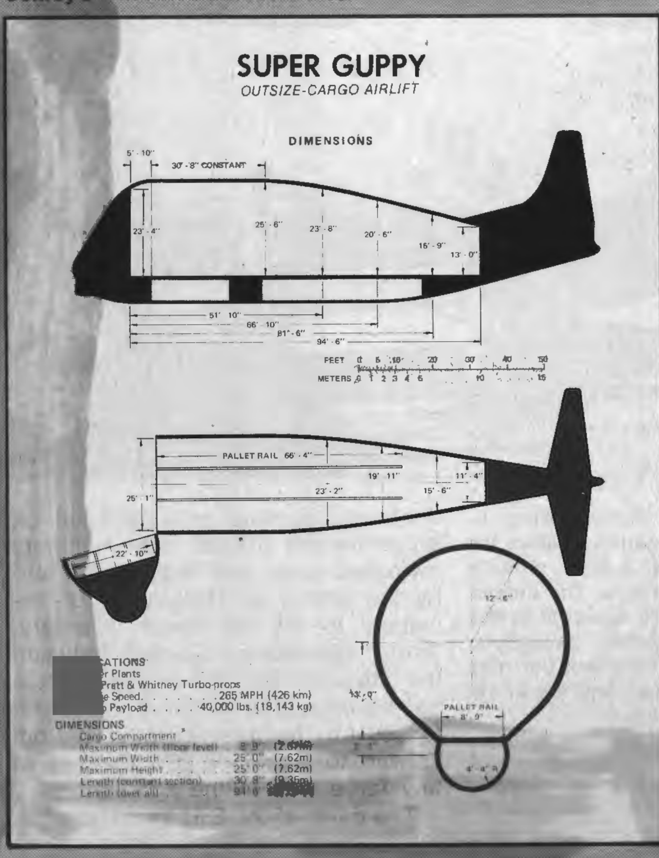


SPECIFICATIONS
4 Pratt & Whitney Piston Engines
Cruise Speed. . . . . . . .240 MPH (386 km)
Cargo Payload . . . . 32,000 lbs. (14,515 kg)

DIMENSIONS
Cargo Compartment
Maximum Width (floor level) 13' 0" (3.96m)
Maximum Width . . . . . . 18' 4" (5.59m)
Maximum Height . . . . . . 15' 6" (4.72m)
Length (constant section). . . 73' 2" (22.30m)
Length (over-all) . . . . . . 91' 6" (27.89m)

The latest Stratocruiser permutation, the Guppy 201. Powered by the same type of engines as the ill-fated Model 101, N211AS has been sold to a European consortium and, with its sister ship (212AS), is being used to haul parts for the A-300 Airbus and other aircraft.

An ancient, derelict Ercoupe at Van Nuys gives a good standard for comparison to determine the size of the first of Conroy's modified Stratocruisers.



modification of the standard C-97 that was powered by four P&W T-34s, each delivering 5,700 hp. The new craft was designated the Super Guppy and was designed to carry the Saturn IVB rocket and the added superstructure increased the inside diameter to 25′ 6″.

A fifteen-foot section was added to the wing and the fuselage was lengthened by 30′ 10″. The nose was designed to open on two hinges that were mounted on the left side of the fuselage. The two Guppies transported 11 of the 13 major Saturn Apollo components for 90 percent of the moon program missions including the command, service and lunar modules. The fuselage of the C-5A or Boeing 747 could pass through the fuselage of the Pregnant Guppy or Super Guppy with room to spare.

Conroy moved to Santa Barbara where he built two more Guppies. These were smaller versions and were called Mini-Guppies. The first Mini-Guppy, completed in just six months, flew to the Paris Air Show only two hours after its maiden flight. The second Mini was the first of the Guppies to have an accident. It was powered by turboprop engines and crashed fatally on a certification flight at Edwards AFB. By this time Conroy had sold the company and retired with the profits to scheme on other plans.

The company constructed huge new hangars at Santa Barbara Airport. They produced two more Guppies for France. These were the largest of the breed and are used to haul parts for the A.300 Airbus and the Concorde program. The company also operated the remaining Guppies on contract work. Unfortunately, times changed. With the wind down in the aero-space business, the Guppies found themselves unwanted and Aero Spacelines went out of business on New Year's Eve of 1973.

The Guppies have been pushed inside the massive hangar and their fate is uncertain. It is hoped that at least one will be given to a museum. The Guppies certainly left a unique mark on aviation history and those that saw them will not forget their majestic size as they flew through the air carrying the equipment that put men on the moon.

CONROY TURBO-THREE OFFERED AS 30-PASSENGER COMMUTER -- Take an aging DC-3 and hang a pair of Rolls-Royce Dart turboprops on the wings and you have what Jack Conroy calls "A new dawn for a grand lady." That was three years ago when father of the outsized Guppy missile transports completed the Dart conversion on a single airplane. In fact, he didn't get the thing certificated and he didn't sell any. Now CAB's Bureau of Operating Rights may indeed have given Conroy's Turbo-Three a new dawn. According to Conroy, the Turbo-Three fits to a tee BOR's recommended 30-passenger, 7,500-pound payload limitations for commuter aircraft in lieu of the current 12,500-pound gross weight restriction (BA, April 12/114).

The only problem, Conroy told BA last week, is the approximately $300,000 it will take to get the conversion certificated. "I haven't been able to certificate it because I haven't sold any and I haven't sold any because it's not certificated." Conroy believes the market is there, however, if CAB adopts the BOR recommendation. Advantages of the Turbo-Three include its initial low cost -- $350,000 to $450,000 including airframe -- low operating and maintenance costs and the almost legendary reputation of the DC-3. "The ride in this airplane is unbelievable. There is no vibration and the noise level is very low with the engines mounted so far forward," he said.

Specifics on the airplane cited by Conroy are impressive. He said the Turbo-Three would cruise at about 230 miles per hour, compared to about 175 for the standard DC-3. Total per hour operating cost was listed at $104, or 63 cents per mile over short stage lengths. In comparing operating costs with other aircraft in the same general class, Conroy said those for the standard DC-3 are 26 per cent higher than the Turbo-Three and 121 per cent higher for the Convair 340/440 (based on 30-passenger loads). He recommends outboard fuel tanks with a 1,140-gallon capacity, which gives the aircraft a 5 1/2-hour range. Inboard tanks could be converted for baggage storage, he added. Conroy said he was just getting started with the Turbo-Three program when he ran out of money, but that the BOR recommendation "has got me excited again." He plans to fly his prototype, with an executive interior, to the Reading Air Show in June.

June 10, 1971 - Page 3

IN-FLIGHT REPORT: TURBO-THREE PROP-JET -- How many transport-type pilots could crawl into a turboprop DC-3 and find themselves operating familiar engines on a strange airframe? Well, reluctantly I must admit to being the new breed of heavy-airplane pilot who has never flown a DC-3--a situation probably near impossible to find a few years ago.

Jack Conroy's Turbo-Three, a Rolls Royce Dart-powered "commuter airliner" (right after government authorities amend current commuter restrictions, that is--an occurence that's expected shortly) will hopefully go into certification tests soon. Except for long-and-thin Viscount-type engines and a few minor cockpit panel changes, the airframe is a straight Douglas transport (Whoops, it has an executive interior and a picture window).

The three areas of turbo versus vintage improvement, according to Jack Conroy and Fish Salmon, are in performance, noise level and operating costs. Let me tell you about the performance and sound.

First, cruise speed is upped to 225 mph from what, I am told, was seldom near the Douglas-planned 170 mph. Rate of climb to 10,000 feet is about 10 minutes. With the right engine snapped back to flight idle, the Turbo-Three dribbled down to slightly over 120 mph while we cruised along at 6,500--using no additional trim, a moderate amount of left rudder and a tad of aileron.

There's only one place quieter than the cabin of the Turbo-Three in cruise--my living room, after the kids have gone to bed. Normal conversation is easier aloft in the -Three than it is in the Reading hangar. Vibration is at fan-jet levels.

Up in the cockpit is another surprise. With all that engine and prop, noise was a little higher than the cabin--but not much. We used speakers for radio work and carried on conversation in normal human tones while we slid across the Eastern Pennsylvania landscape at a couple of thousand feet. Except for 14,000 rpm on the tachometers, it was 1938 and Air Mail Route 21 all over again. -- Thomas H. Block, Contributing Editor, FLYING

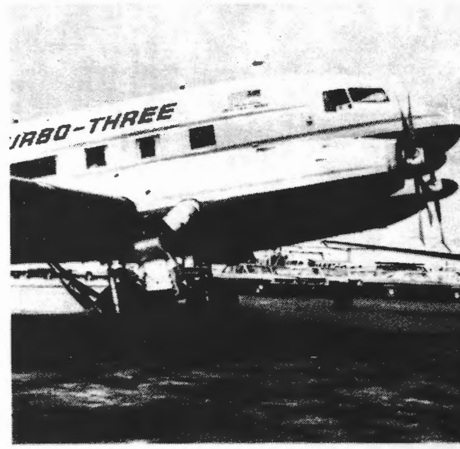
Business & Commercial Aviation

July 1971

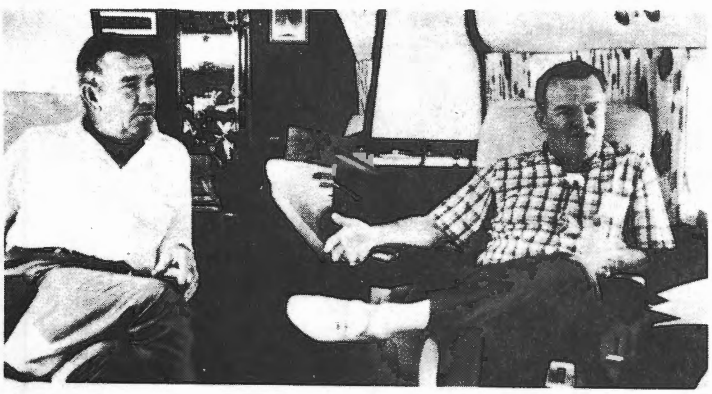
FUTURE OF CONROY'S DART TURBOPROP-POWERED DC-3 rests, indirectly, with the CAB, which is currently considering replacing the 12,500 lb rule with a maximum seating rule for commuter liners. If CAB decides on a 30-seat maximum, the turbinized DC-3 should be a very compelling choice for the commuter airlines. At least that's the reasoning of John Conroy, president of the Turbo-Three Corp, Santa Barbara, Calif.

An hour's flight at the Reading show in Conroy's demonstrator—which, in piston form, flew for many years with Monsanto Chemical—showed the airplane to be quiet (the prop arc is ahead of the cockpit), fast (220 mph cruise at 8500 ft and 1500 fpm climb at 100 mph), rotate at 80 mph and approach at 85 mph but, otherwise, fly like a DC-3.

Conroy estimates he could have the new airplane certified in six months. Max gross would be 31,900 lb. He figures on asking $400,000 for the airplane without avionics. Operating costs, Conroy calculates, would be $104.86 per hr and on short stage lengths $0.635 smi or, with 30 passengers, $0.021 per seat mile—which is cheaper than existing prop-driven airliners, the piston-powered DC-3 included.

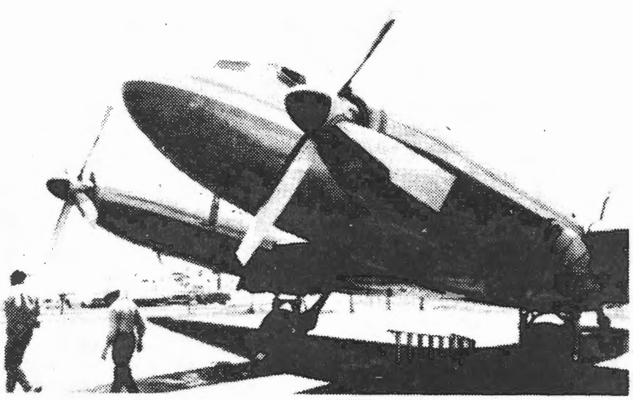


Long, lean nacelles on turboprop-powered DC-3 put props forward of cockpit.



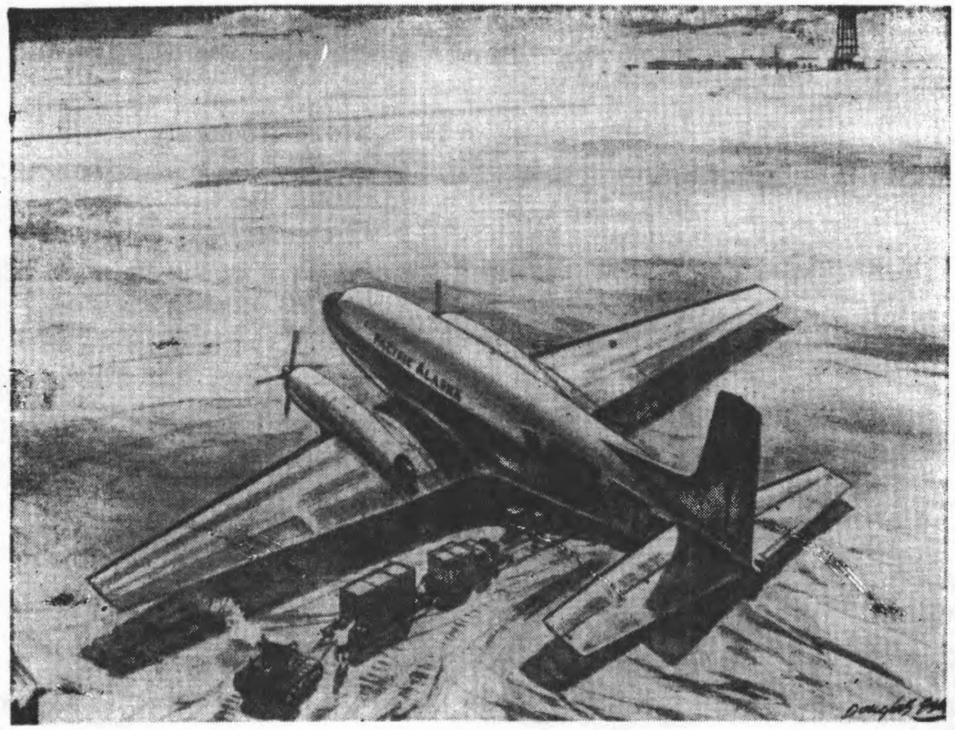
At left (top) Herman "Fish" Salmon and Jack Conroy (right) relax in cabin of Dart-powered DC-3 before demo flight.

Mon., June 14, 1971 — GENERAL AVIATION NEWS—



First making its appearance 2 years ago and now revived, is the Conroy Turbo-Three . . . a DC-3 conversion using Rolls Royce Dart engines from discontinued Vickers Viscounts. Conversion was brought from limbo by Jack to meet needs of the new rules for Commuter lines. Speed is up to 225 mph and range to 2000 miles or more. Noise level is reported to be extremely low with modifications.

Los Angeles Times
Business & Finance
9 Part III THURSDAY, DECEMBER 27, 1973 ★



OLDTIMER'S NEW LOOK—In its all-cargo configuration, shown here, new version of the DC-3 lends itself to operation on Alaska's North Slope, one aim of plane's designers. In this form, it can carry up to 7,500 pounds. New tail configuration and turboprop engines are major changes.

NORTH TO ALASKA

Venerable DC-3 to Fly Again as 'Super Turbo-3'

BY MARVIN MILES
Times Aerospace Writer

The perennial Douglas DC-3 that revolutionized commercial aviation 38 years ago will soon have a modernized successor in much the same mold, but with stepped-up performance.

Less than 25% of the famed old "Gooney Bird" will be incorporated in the new aircraft, called the Super Turbo-Three, but its genesis will be readily recognizable in the configuration of wings, fuselage and cockpit.

The new SST, powered with Rolls Royce Dart turboprop engines, will be produced by the Turbo-Three Corp., Santa Barbara, with the prototype scheduled for first flight next month, according to John M. Conroy, president of the firm.

Exesting DC-3s will be modified by Turbo-Three into the new STTs.

Conroy, who as a pilot established several jet speed records, is the founder and former president of Aero Spacelines. He was responsible for development of giant cargo-carrying aircraft, including the Pregnant Guppy.

The new STT, powered with Rolls squarely at the Alaskan North Slope oil operation and the domestic airline commuter market.

"The Alaskan pipeline go-ahead creates an immediate market for the aircraft in straight cargo or combination passenger/cargo configuration."

The new twin-engine aircraft will have approximately 40% more power than the piston-engine DC-3, with a cruising speed of 250 m.p.h., compared with the Gooney's 195 m.p.h.

Airframe modifications include strengthened outer wings for higher speed, reinforced center wing, lengthened fuselage and completely new tail surfaces.

Among systems changes will be full-closing main gear doors, a retractable tail wheel, heated windshield, outer-wing fuel tanks and air conditioning, plus greater head room and low noise and vibration levels, Conroy said.

Future options, he added, will include a nose wheel configuration and cabin pressurization.

The STT should be certificated in April, within the commuter airline weight limitation, and deliveries, planned at the rate of one a month, could begin by early May, Conroy said.

Basic price of the cargo aircraft will be approximately $475,000.

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THE GUPPIES

By Dave Esler

Among the photographs and memorabilia assembled on a wall in Jack Conroy's Santa Barbara, California home is a scrap of paper. On it is written in ball point pen: "If I could only get across to people the extreme difficulty of starting anything new." —Charles F. Kettering.

Such a plea is quite appropriate for the man who fathered the Guppies, those flamboyant bloated airplanes that defied the doomsday predictions of an army of armchair oddsmakers, contributed materially to the success of the Apollo space program and made a personal fortune for their creator. The story of the Guppies is the story of Jack Conroy, for these incredible airplanes were merely a reflection of the stocky Irishman's personality. During a seven-year period in the 1960s, the planes were built and flown through Conroy's sheer force of will and nary a dime of government support.

Conroy was a contractor and non-sched airline pilot in 1960 when the idea of converting a conventional transport aircraft to carry "outsize" cargo began to gnaw at his psyche.

What's it take to make a guppy pregnant? A reach-for-the-moon imagination, plenty of fast talking—and a sense of humor.

The fact that he was not an engineer, had no great sums of money, nor had ever built an aircraft before didn't deter him in the slightest.

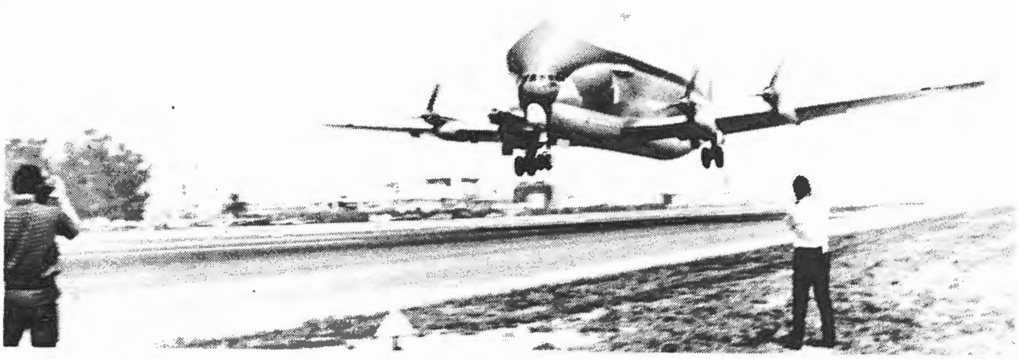
Transportation of cargo by air, he reasoned, had been limited by the size of the aircraft. Nearly all transports had been designed with two things in mind: speed and comfort. Most cargo aircraft had been adapted from airliners and were limited by their pencil-thin fuselages.

At about this time Conroy was a weekend pilot in the Cal Air Guard, flying Boeing C-97s. "The Stratocruiser was an excellent prospect for modification," he said. "The configuration of the plane easily lent itself to extension, and the double-bubble fuselage provided a good place to break at the floor. Crew cabins were pressurized, the planes had radar, and most important, they were available and cheap."

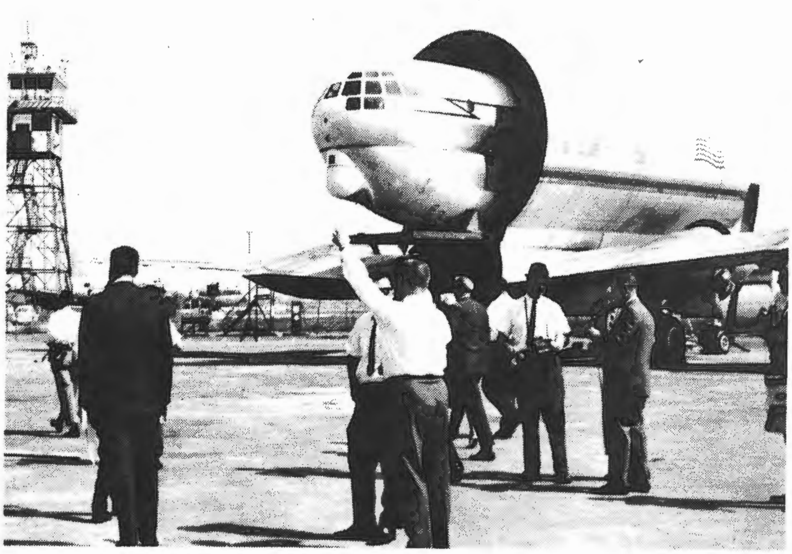
Conroy took his idea to Lee Mansdorf, a California aircraft broker who'd bought up many Stratocruisers. Mansdorf agreed to supply airframes for conversion but no financing. Together Conroy and Mansdorf embarked on a frustrating—and frequently futile—quest for financial backing.

One day Mansdorf came across a magazine article describing various NASA proposals for moving Apollo hardware up and down the California coast during construction, and to Cape Kennedy for launching. Mansdorf showed the article to Conroy. "Why not modify a Stratocruiser to do the job?" he asked.

That's all Jack needed. He quit his flying job, mortgaged his house, furniture and car, and borrowed as much money as he could from his



The impoverished Conroy had to build the first Pregnant Guppy outside because he couldn't afford a factory. Work proceeded on a day-to-day basis as he prodded the FAA and scrounged up funds. The Guppies' cavernous wombs have carried Apollo and Saturn hardware, outsized oil rigs and, more recently, fuselage sections of the European A-300 Airbus.



friends. The final sum came to a paltry $15,000, not much for building the world's largest aircraft.

Gathering up his drawings, Mr. Conroy went to Washington.

His reception was cool. NASA officials were skeptical. The thing couldn't fly, they said. Impossible. NASA could provide no backing, but if Conroy wanted to prepare an aircraft on speculation, they might be interested. "You see, Mr. Conroy," said one official, "we still haven't found a way to move that big hardware around economically."

During a break in the talks, Conroy had stepped out for a minute to make a phone call. While still outside, he overheard a guffaw from the office. "Why the damn thing looks like a pregnant guppy," chortled one of the bureaucrats. "Yeah," thought Conroy to himself, "you just wait and see."

Back in California Conroy formed a corporation, Aerospace Lines, and continued the fight to raise money for his outlandish project. Mansdorf brought a Stratocruiser to Van Nuys Airport, and construction began.

Throughout 1961 the project progressed at a guppy's pace. "We'd scrape up enough to make a payroll, and the construction would move ahead for a few days," Conroy reminisced.

Clay Lacy, who has a neighboring office at Van Nuys, remembers those uncertain days, too. "You could tell what kind of progress they were making by the sound of the rivet guns," he said. "If the air was being ripped up by a staccato of rivet guns, then you could be pretty sure Jack had found some bread. If only a few guns, then it was a fair day, and if it was quiet, then we'd know they were out of money again."

To save money, Conroy decided to set up shop out of doors. The Stratocruiser began to gestate in full view of the San Fernando Valley.

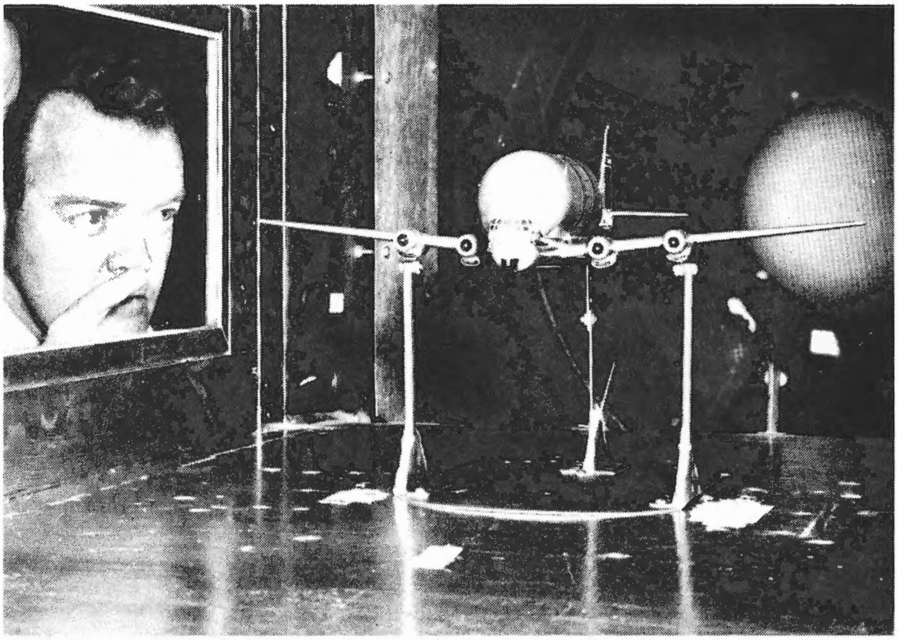
The finished airplane was about as subtle as a karate chop. Conroy allowed himself the luxury of revenge and christened the blimp-like machine "Pregnant Guppy" in deference to his loudmouthed NASA critic.

While the never-ending fight for financing was progressing during the 18-month construction period, Conroy was waging another battle with the Feds. "There's no way that plane's going to leave this runway," the FAA declared.

To make matters worse, every engineer in the San Fernando Valley (and that's a considerable group of slide-rule jockies) had a pet theory about why the plane wouldn't fly. "They were completely convinced it would crash," said Jack. "It wasn't a matter of 'if,' just 'when' and 'where.' "

Nevertheless, Conroy wheedled permission for some high-speed taxi tests. Optimistically, he also set a date for the first flight, while his most influential backer, Lloyd Dorsett of Oklahoma, continued to needle the FAA in Washington.

Jack Conroy peers at a wind-tunnel model of his progeny.



Conroy planned to fly the plane himself, but he needed a copilot with lots of Stratocruiser/C-97 experience. He asked Lacy.

"I'd been telling everyone all along that the plane would be a success," said Clay, "never thinking, of course, that I'd be inside the damn thing when it rolled down the runway. When Jack asked me to fly it with him, I had to put up or shut up. I couldn't refuse."

With flight engineer Bob D'Agostini, Conroy and his shanghaied copilot, Lacy, cranked up the four P&W R4360s on the Guppy and carried out 15 practice runs, pulling the plane off the runway and letting it back down again, checking rudder response and rehearsing engine-out drills. Results were encouraging. The plane exhibited nearly normal flight characteristics, despite the huge bulk and 5,000 pounds of extra weight.

When the airport commission realized that Conroy was actually serious about flying the plane from Van Nuys, elaborate briefings were arranged with police and fire officials to handle the impending disaster. The crew was required to memorize the location of every school and hospital along the flight path.

By the morning of September 19, 1962, the designated first-flight date, more than 1,000 policemen had been diverted from regular duty in the Los Angeles area to block off every street along the Guppy's projected takeoff route from Van Nuys to Ventura. Hundreds of firemen and countless pieces of emergency equipment were moved into the Van Nuys area and the hills near the airport. Highways were jammed with spectators. The local Lockheed factory suspended operations and turned its employees out into the parking lots to witness the impending disaster, and newsmen

The Super Guppy 201, powered by Allison turboprops. Below, where it all started: the original Pregnant Guppy makes its first flight on September 19, 1962.

packed into an airliner Conroy had chartered for the occasion.

By 10:30 a.m. permission had still not been granted by the FAA. Finally, a half hour later, a typewritten letter was delivered to Conroy from the local FAA office. It was the green light. Dorsett had been successful.

Of course, the plane did fly, with good stability to boot. "Because of the lengthened tail moment," reported Lacy, "the empennage control surfaces were 30 percent more efficient than those of the stock Stratocruiser. Flight characteristics were better all around."

"In fact," he continued, "our experience with the plane completely discredited the existing aeronautical drag formula. The engineers had predicted a 40-mph speed loss, but the aircraft was only five mph slower than normal."

When they set the plane down at Palmdale and disembarked, a TV reporter stuck a microphone into Conroy's face and asked him how the Pregnant Guppy had responded.

"Why, hell," the little Irishman replied, "we knew this one would fly. It's the big one we're worried about!"

"Oh Gawd," Lacy groaned under his breath. Conroy was already thinking about a larger airplane.

Sixty hours of FAA-required flight tests demonstrated the PG to indeed be a stable aircraft. During a demonstration to NASA officials at Huntsville, Alabama, Conroy allowed Dr. Werner Von Braun to fly the fully-loaded Guppy from the copilot's seat. The scientist had never flown anything larger than an Aero Commander, but he did quite well bringing the plane up to altitude, whereupon Conroy signaled the flight engineer to kill engines one and two while he surreptitiously cranked in corrective rudder trim. As the power plants are not directly visible from the cockpit, Von Braun was unaware that he was now flying a 133,000-pound twin-engine airplane.

Presently, one of Von Braun's aides, who was riding in the aft cockpit, noticed the frozen props and called, "Professor Von Braun! Professor Von Braun! Two engines have stopped!"

When Von Braun queried Conroy about it, Jack deadpanned, "Oh, we do that all the time to save gas."

It was a dirty trick to play on the space program's leading scientist, but it adequately demonstrated the monstrous plane's pussy cat tendencies. The aircraft was immediately pressed into service hauling S-IV stages and related components throughout the country, while Conroy—at Von Braun's suggestion—began to explore possibilities for an even larger airplane, the Super Guppy.

This aircraft, also constructed at Van Nuys under the rickety scaffolding, used one of only two remaining YC-97J airframes as a basis. The YC-97J was a turboprop conversion of the B-377, powered by four P&W T-34 turbines, each delivering 5700 reliable little ponies. The plane was designed to carry the larger S-IVB stage of the Saturn V launch vehicle, and the added fuselage decking increased the inside diameter of the body to 25 feet 6 inches. A 15-foot center section was added to the wing (another feat the engineers said was impossible), and the fuselage lengthened by 30 feet 10 inches. The rudder/stab was raised considerably and the horizonal stab/elevator area increased. Two hinges were installed on the left side of the forward fuselage so that the entire nose section could be swung aside for loading.

Operating on special FAA permits, the two planes transported 11 of the 13 major Saturn Apollo components for 90 percent of the moon program missions including the command, service and lunar modules; the lunar module adapter; an instrument unit; the S-IVB stage, and five F-5 engines for the first stage.

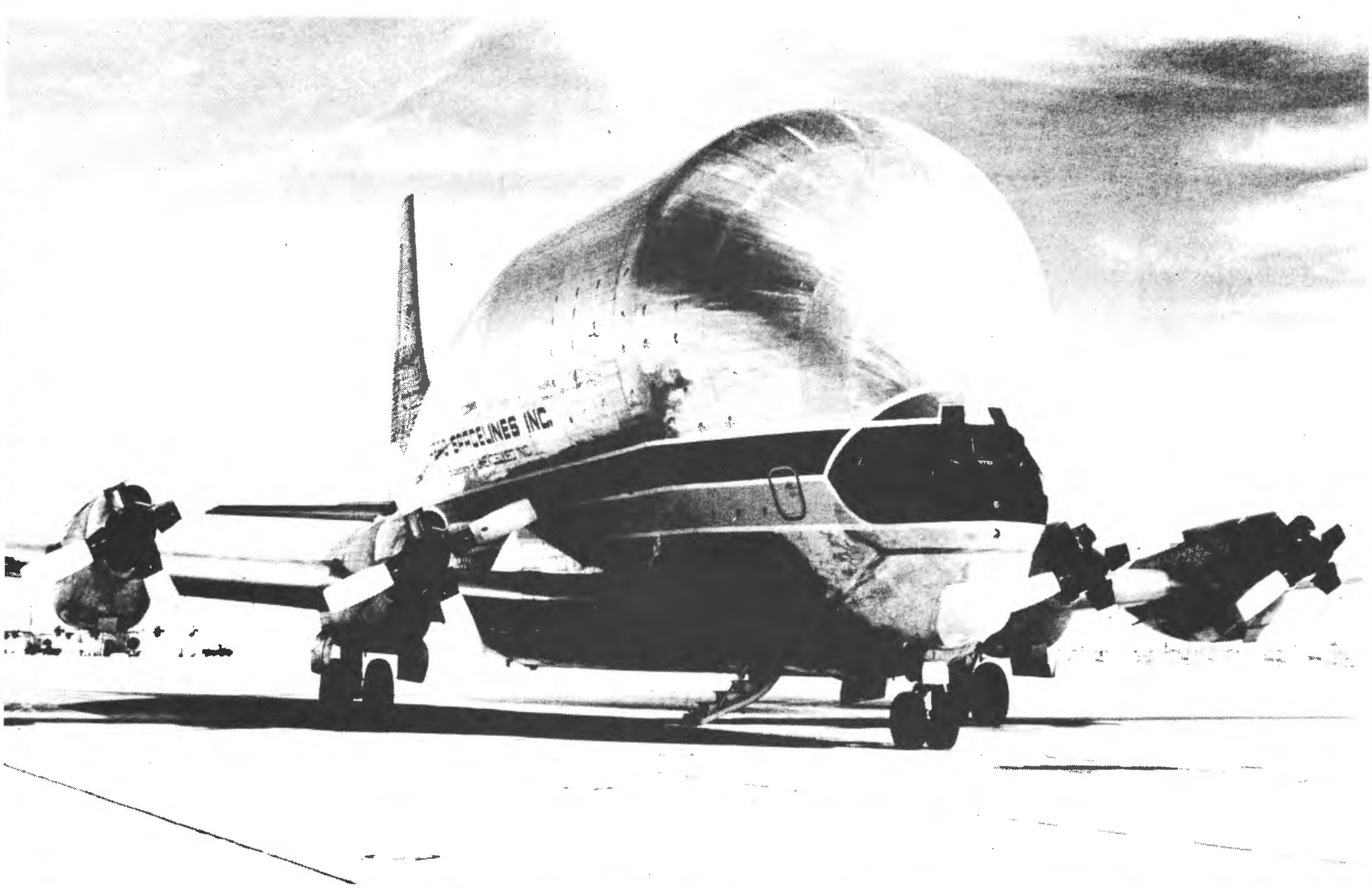
In terms of volume, the Guppies are probably the largest aircraft ever built. If the ends of both PG or SG fuselages were lopped off, the fuselages of either the C-5A or Boeing 747 could slide right through.

Conroy, by now christened "the man who made the guppies pregnant," built two more Guppies, slightly smaller versions called "Minis." Then he sold out his stock in Aerospace Lines for more than a million dollars a few years ago. The first Mini-Guppy, completed in just six months, flew to the Paris Air Show only two hours after its maiden flight. The second Mini, powered by Allison 501 turboprop engines, crashed during certification testing at Edwards AFB.

Presently, the PG, SG and MG aircraft are being operated in various government and commercial roles by Aerospace Lines at Santa Barbara. A commercially certified Super Guppy, the 201, was recently sold to a European air cargo firm. A second 201 is under construction.

Since his "retirement" Conroy has invested his million dollars in several other projects, including a turboprop conversion of the DC-3 and another blown-up cargo plane, this one based on the Canadair CL-44. At the age of 51 he feels his life is just beginning. His eyes twinkle like those of a leprechaun when he talks about the thousand and one other ideas that have spilled from his fertile brain, and the set of his chin still reveals the cockiness and unabashed self-confidence known only too well to the government agencies he collided with during the '60s.

He still laughs about a proposed superplane he planned to assemble from parts of the British Saunders-Roe Princess flying boat. "The British thought it was vulgar when we christened the original B-377 'Pregnant Guppy.' Man, can you imagine what they'd say if we unveiled the 'Pregnant Princess?' " □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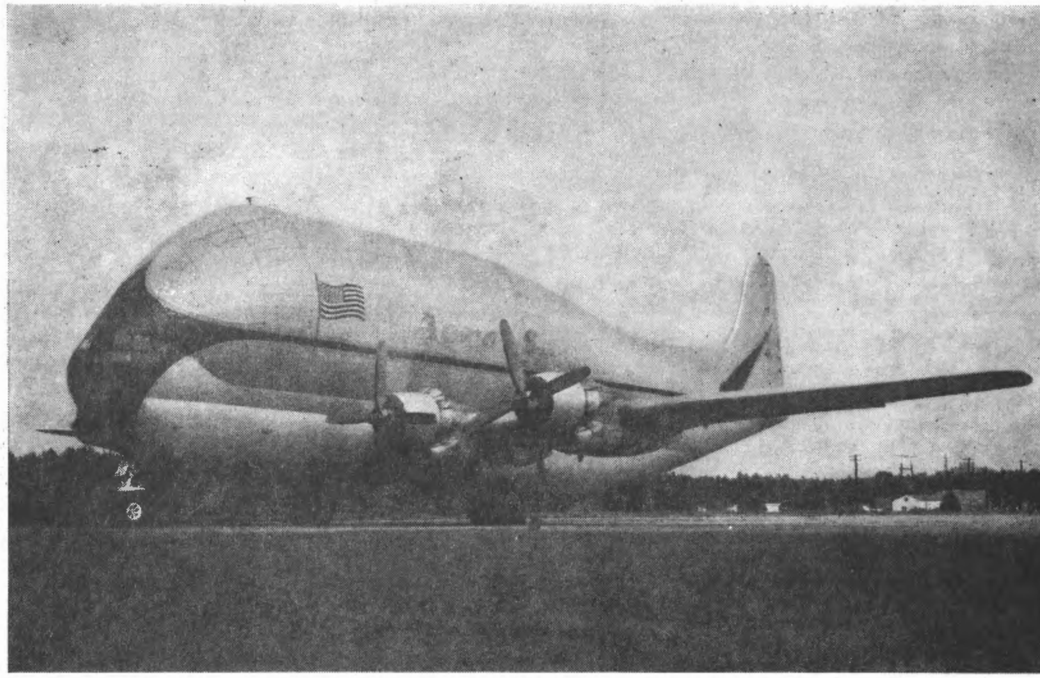

A stretched, heightened version of the Stratocruiser, the "Pregnant Guppy" made builder a fortune.

BY CORNELIUS JOHNS

■ Every time Jack Conroy explained his idea to a potential investor in 1960 he got the same result: amazement that anyone in his right mind would try to build an airplane the size he described. An Air National Guard pilot who had flown in World War II, Conroy was not an engineer, had never before built an airplane of any kind, and some of the country's best known aeronautical experts had predicted that such a plane could not fly. Furthermore, although Conroy had made a comfortable living as a swimming-pool builder and a nonscheduled-airline cargo pilot, he had no money. He did have a stubborn streak and a firm conviction that he was right.

The National Aeronautics and Space Administration had been looking for a quick and reliable means of hauling the upper stage of the Saturn rocket from the Douglas Aircraft assembly plant at Santa Monica, California, to the Sacramento test area and then to Cape Canaveral (now Cape Kennedy), Florida, for launching. Well over 18 feet in diameter and 41 feet long, it was far too large for highway or rail movement; marine transportation was too slow, and no existing airplane was big enough to haul it.

Conroy had a solution: Simply expand the size of an existing airplane.

A Burbank, California, airplane dealer named Lee Mansdorf agreed to invest several Boeing Stratocruisers, long since retired from airline service, if Conroy could find money to get the company going. That was all Conroy needed. He quit his job and began looking for money. Several months later, with less than $15,000 obtained by borrowing from friends and mortgaging his house, furniture and automobile, he started modifying the Stratocruiser to make it, in diameter and cargo capacity, the world's largest airplane. First, he lengthened the fuselage 16½ feet. Then he cut off the top half of the fuselage and built a new one large enough to hold the Saturn rocket. Finally he cut the plane in half just behind the wing and fitted the two sections together with bolts so that they could be separated for loading.

The result was a plane which looked like a huge, misshapen blimp with wings, which he named the "Pregnant Guppy."

Jack Conroy is a personable blond, square-jawed Irishman, both enthusiastic and persuasive. This is fortunate for, before the airplane was completed, he had spent over a million dollars, and investors were nervously demanding repayment of their loans.

When he taxied his awkward-looking airplane out to the end of the Van Nuys, California, airport runway on September 19, 1962, he knew that his future depended directly on the success of this first flight. A huge crowd watched as the plane lumbered down the runway, its four engines throbbing. Finally it leaped clear of the runway and soared into the air. It was a perfect flight for the world's largest airplane and vindication of Conroy's faith. But it did little to lessen his troubles.

Modifications had to be made and a flight-test program conducted before the plane could be certified for flight. While this was going on, he had to find additional funds and persuade those who had already invested to wait for their money. Finally he obtained certification and negotiated his first contract with NASA to haul Saturn's upper stage. Now he was in business, but he was not out of the woods.

To obtain enough money to complete the airplane, he had borrowed $400,000 from a group of investors who retained the voting power of the corporation's stock and, in effect, controlled the corporation. When Conroy and this group differed over his plans to build another airplane, he was fired. Still a stockholder, he went back to work raising money and persuading other stockholders to restore him to office. Months later, after a bitter fight, he again took over the corporation.

Calling his one-airplane line Aero Spacelines, Inc., he was hauling NASA and Air Force cargo at an increasing rate. Believing in a promising future for such an airline and firmly in control of the company, he convinced his backers to let him build another, even larger, airplane.

By now, NASA was looking for a means of hauling the upper stage of the moon rocket, too big a cargo even for the Pregnant Guppy. Conroy found an Air Force surplus C-97 (a military version of the Stratocruiser and considerably more powerful) which he bought for $30,000. Eight months and several million dollars later, he had transformed it into a gigantic plane which he called the "Super Guppy." Its fuselage is wider and higher by far than any airplane flying today. Its tail is as tall as a four-story building. The highest point of its fuselage is twice

'GUPPY' MAKER THINKING BIGGER' PLANNING NEW CARGO CRAFT

By Tom Maurice

GOLETA - John M. (Jack) Conroy, the "Guppy maker" is thinking even bigger.

But unlike past efforts, this time the critics of his outsized cargo planes, are not so likely to scoff.

Conroy, who moved his operations to the Santa Barbara Airport in the Goleta Valley last year, is now planning to build a six-engine turbo-prop cargo plane that will be even larger than the Super Guppy now used for NASA cargo flights. The new version - if built - would then become the world's largest airplane, Conroy said.

Conroy has already made aviation history (Golden Coast News, May 18, 1967), with his Super Guppy, Pregnant Guppy and Mini-Guppy, which he exhibited in the recent International Air Show in Paris.

His achievements brought him the U. S. Medal at the air show for greatest contribution to aerospace made by a U. S. citizen during the past two years.

The Paris air show left him with definite impressions on the international aspects of aerospace.

"Our plane was the only thing really new at the show," Conroy said. "It was parked next to the new U. S. jet the F-111. The Russians had a tremendous outdoor display, while the U. S. pavillion exhibit was by far the outstanding indoor dispaly. The Russians had a great variety of spacecraft on display. The size and complexity of their vehicles was enlightening. One thing interesting to our space scientists was that contrary to popular belief that the Russian cosmonaut launch vehicle was a huge single booster, it was instead a cluster of smaller rockets, consisting of four liquid strap-ons which were jettisoned.

"The Russian aircraft display was also interesting - although I don't think they had anything particularly new. They displayed the Aleutian Jet which is supposed to be introduced for commercial flights late this year between Moscow and New York. Their turbo-prop cargo plane, Antonov 22 had interior dimensions that appeared to have the same capacity as the Mini-Guppy, but it can lift four to five times the weight because of its tremendous power and wing area.

"Another thing that impressed me was the size of the Russian helicopters. Some models would carry up to 100 passengers."

Conroy received one of about a dozen medals presented to an individual from each country. The typical European pomp and splendor with the rows of soldiers in polished helmets, and champagne and caviar buffet, in very lavish Paris City Hall were moments for Conroy to remember concerning the ceremonies for presentation of the medals.

Such moments were far removed from Sept. 19, 1962, when Conroy climbed into the cockpit of the first Guppy at Van Nuys Airport and flew it while a large, skeptical crowd waited for a fantastic crash.

Conroy can be considered as one of the last great individual promoters in aviation history. He is the type of likeable Irishman who has taken such high chances against great odds that you want to root for him.

His company, Aero Spacelines Inc., is now a subsidiary of Unexcelled Corp., a publicly-held company, but there was a time a few short years ago, when the daring Irishman played a change-the-locks and post-your-own-security-guards game with some stockholders in Van Nuys who didn't approve of his ambitious ideas.

Conroy was born in Buffalo, New York, December 14, 1920, and grew up in Sand Springs, Oklahoma, near Tulsa, where his father opened the first steel mill west of the Mississippi River. He finished high school in three years with high grades and decided to seek an acting career. His father wanted him to study engineering, but young Conroy had other ideas, hopped a freight and headed for Hollywood. He did get several small, bit parts in films, but decided to go to Hawaii when filmdom didn't overwhelm him with offers.

Construction work at an airfield in Hawaii led him into the world of flying. When the Japanese bombed Pearl Harbor, Conroy watched from beneath a harbor crane. He was an eye witness to the sinking of the battleship, Arizona.

He had previously been turned down for naval flight training because his upper and lower rows of teeth didn't match. Pearl Harbor made him determined to get into military flying. The Army wanted pilots more than men whose rows of teeth matched and they took him.

He wound up flying 17 missions in Flying Fortresses over Germany, and got shot down on the 18th mission. His right arm was broken and his right shoulder dislocated, but he managed to open the chute with his left arm.

After the service, came stints as an airline pilot, flying in Central America, and operating his own small flight service, and building swimming pools in Southern California.

All the while he kept on flying and set two transcontinental day records from Los Angeles to New York and back - first in an F-86 Sabrejet, then in an executive Lear Jet. On the second flight in the Lear Jet he took along his three children, Barbara, Tim and Bill.

Then came the idea to convert Boeing Stratocruisers into outsized aircraft for hauling cargo too big for the regular commercial lines. Several years of touch and go, and playing a game of chess with banks and backers went by before he landed a contract with NASA.

Conroy said he expects that Aero Spacelines will soon complete a sale or lease with a French company for the Mini-Guppy. First it will take three to four months of flight tests and FAA certification.

His next immediate plans are to remove the Pregnant Guppy from service and refurbish it. An entirely new wing section will give it the same wing area as the Super and Mini, but it will be 15 feet longer. Immediately following that, Conroy said the company has plans to start construction on an entirely new six-engine turbo-prop Guppy that will be a commercial version of the Super.

If the company builds the six-engine Guppy, it would have to be done in large hangars, and Conroy hopes to work out new lease areas with the Santa Barbara Airport for this work.

Conroy feels that commercial air cargo has a big future, and that Aero Spacelines has no competion in carrying outsize cargo. "We are not interested in general air cargo or competing with commercial airlines - only in carrying cargo too big for the commercial lines to handle."

Conroy holds the Distinguished Flying Cross, Air Medal, and Purple Heart. He has more than 18,000 hours flying time. He is president of Aero Spacelines, Inc.

Conroy likes to fish in his spare time. He gave up working seven days a week as a bad habit, and now likes to fly to Baja, California, or to Idaho in his Grumman amphibian. He still doesn't take vacations, only "extended week ends."

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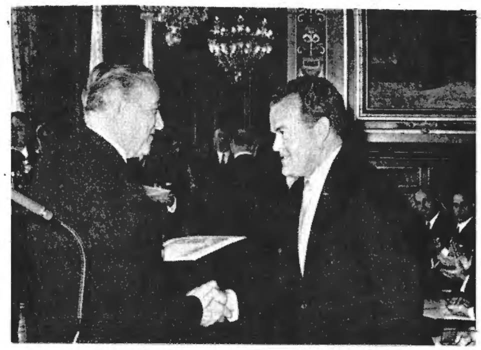
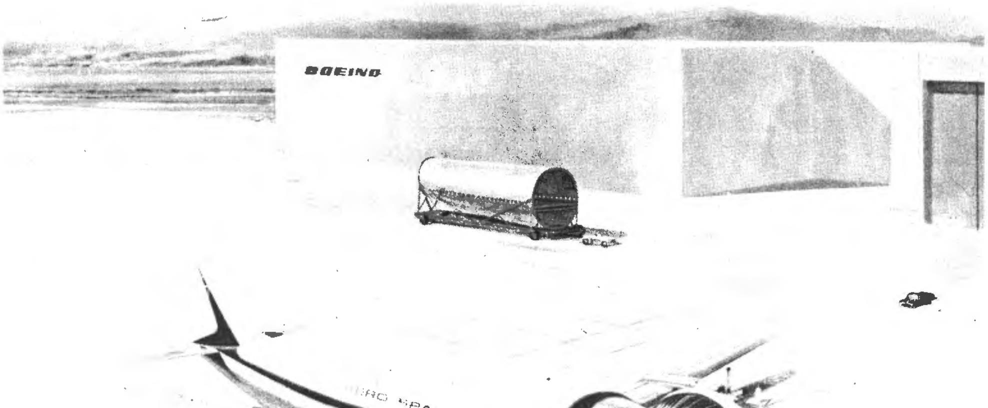
Honor guard flanks corridor of the City Hall in Paris where John M. Conroy, maker of the Guppy airplanes based at the Santa Barbara Airport, received his medal at International Air Show in Paris.



Presentation of medal at the International Air Show in Paris was made by Paul Faber, left, President of the Council Municipal de Paris, to John M. Conroy, President of Aero Spacelines, Inc. of Santa Barbara.

Champagne toast followed medal presentation ceremonies at the air show. From the left are Barbara Conroy, Mrs. John (Milbrey) Conroy, John Conroy, and Mrs. Celestine Stowe, Conroy's mother.



New six-engine turbo-prop Guppy planned by Aero Spacelines at Santa Barbara Airport is shown in new artist's conception. Nose section is from the new Boeing 747 "Jumbo Jet" being built in Seattle. Fuselage is shown at rear. Rendering shows how the new, largest version of the "Guppies" could transport sections of the huge jet by air from various subcontractors.

Reprint from Golden Coast News, Santa Barbara, California (20 July 1968)

that of our largest commercial jet liners.

The Aero Spacelines guppy fleet now includes a third airplane, the "Mini Guppy." It is slightly smaller in diameter than the Pregnant Guppy, but it is longer. Built in five months, Conroy flew it across the Atlantic to the Paris Air Show. The trip was made with less than 20 hours of previous flying time on the airplane.

Conroy predicted that the existence of his fleet of supercargo planes would influence manufacturing processes. It did. Aircraft and heavy-tool manufacturers have wrestled for years with the logistics of moving heavy assembled items, and their products are growing in size, weight and complexity. Conroy's fleet provided a ready-made solution to this problem. He set out to sell his airline's service to haul oil-drilling equipment to Alaska and Iran and assembled aircraft fuselages and wing sections, helicopters, heavy tools and computers. Then he began negotiating to establish a European auto-air ferry. Soon, European aircraft and rocket manufacturers were knocking on his door, with requests that he haul assembled components from factory to assembly site and to launch sites in French Guiana and Australia.

Conroy was happy to oblige. With his airline grossing around $4 million a year, and the business outlook good, he carefully avoided direct competition with other cargo lines. He insisted that "when something is too big or too heavy for them, we'll haul it; otherwise, it belongs to them."

The arrangement has been a fortunate one. There has been an increasing amount of heavy cargo, far too large to be loaded into any existing or planned conventional airplane, including the monstrous C-5A now being completed by Lockheed.

Suddenly, when business was at its best, Conroy proved to be still unpredictable. He resigned as president of the company, sold all his stock for, in his words, "well over a million bucks," bought a third-hand DC-3, loaded his family aboard and set out for an extended and long overdue vacation in Bermuda.

When he returned, he had lost none of his enthusiasm and drive. Since then, he has built a successful aerobatic airplane, with plans for more, and he has developed a new concept in seaplane flotation gear which he feels has great promise. With his past record of performance, no one argues with him.

He has an impressive record and an energetic drive that leaves competitors out of breath in the stretch.

Most men reach for a cup of coffee when they get up in the morning. Not Conroy. He grabs a telephone and gets to work. He eats breakfast in the dining alcove of his comfortable ranch home in the Santa Barbara foothills overlooking the airport. A shortwave radio tuned to the airport tower frequency keeps him in touch with operations there.

He works now in his home, loaded with papers, aviation magazines and framed citations. He proudly points out the Citation of Honor from the Air Force Association for setting a speed record in 1955: he flew an Air National Guard F-86 from Van Nuys to New York and back in 11 hours, 26 minutes and 33 seconds. The International Aero Classic Award was given to him for setting a new speed record for commercial aircraft, again across country and return, this time in a Lear Jet exactly 10 years after his first record flight. The Mayor of Paris just last year presented him with the Medal of the City of Paris for being the American who has made the greatest contribution to advancements in aerospace.

Prominently displayed on the wall is a large photograph of Conroy standing before the Pregnant Guppy with Dr. Wernher von Braun, the space scientist. It bears the inscription, "To Jack Conroy, my fabulous friend who made the guppies pregnant."

Conroy likes to tell his friends that he is getting out of the aircraft business to spend his time fishing. But no one who knows him believes it. He is too much a part of the growing aviation business. ■

Santa Barbara, Calif., News-Press, Thurs. Evening, April 2, 1970

'Engineer of Year' Award to Conroy

John M. Conroy, president of the Conroy Aircraft Co. of Santa Barbara, has been presented "for outstanding contributions to the professional engineering community" with the "Engineer of the Year—1970" award by the San Fernando Valley Engineers Council.

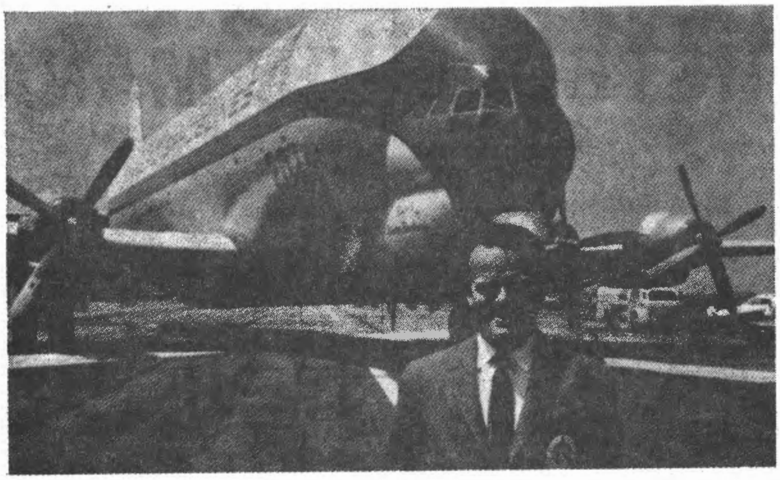
Two such plaques were presented to Conroy and to William M. Magruder, Lockheed Aircraft commercial engineering deputy director, at a dinner meeting recently at the Knollwood Country Club, Granada Hills, with William P. Lear, Lear Motors president, giving the key address.

"For outstanding contributions to the professional engineering community activities in the design and development of the 'outsized' cargo aircraft concept, and unselfish contributions to his community, this award is made," it was stated.

Meantime, Conroy's first CL-44 Canadair cargo plane converted here to a larger size and fitted with jetprops, has completed Federal Aviation Administration tests at Edwards Air Force Base. A full certificate for permission to put the plane into service is expected soon.

The converted Grumman Albatross, which made its first flight recently, does not require further certification since it is for sales to military and civil authorities abroad.

JOHN M. CONROY
'Engineer of Year'



Conroy, with Mini Guppy

THINK BIGGER! new planes accommodate outsize cargo

World's roomiest cargo aircraft, hitherto reserved for military and space-program loads, can soon carry monster loads for you on a commercial basis.

One of the most capacious cargo aircraft in the world will soon be at your service.

That's a picture of it above, with the man who makes it available to you. He is John M. Conroy, president of Aero Spacelines, which owns the Mini Guppy in the photograph, as well as even bigger craft at present reserved for military and NASA cargoes.

Any description of the service the Mini Guppy offers you, and what you can expect from other, larger planes which will be available, lacks a whole dimension if Conroy is left out of the picture.

It was his idea to modify surplus Boeing Stratocruisers into cargo transports. He found that most of them had been bought up by one man, Lee Mansdorf. Mansdorf was willing to supply planes for the venture, and added the idea of revamping them to carry outsize Saturn rocket parts. It was left to Conroy to complete the final design for the rebuilding, and find investors to bankroll the alterations.

Experts said that the first ship, the Pregnant Guppy, would be incapable of flying. They also said it would take five years to make the changes planned. As it turned out, Aero Spacelines added 200 inches to the

Skylounge

Mini Guppy

fuselage length, increased the clear interior diameter to more than 19 feet, and made a successful test flight less than two years after the project was started.

That first flight was on September 19, 1962. Since 1963 the whole capacity of the Pregnant Guppy and the Super Guppy, a larger version completed in 1965, have been on contract exclusively to NASA. The Guppies have transported every section of the Saturn 5 rocket (except 1st and 2nd stages) to Cape Kennedy from contractors all over the country. They have also been used to transport outsize assemblies pertaining to the Agena, Apollo, Centaur, Gemini, Pegasus, Surveyor, and Titan programs.

Now for commercial cargo: Last month Aero Spacelines broke out of the NASA-military restriction with a new modification, the Mini Guppy, built specifically for commercial cargo carriage. Conroy accomplished its introduction with typical elan. They test-flew the Mini Guppy on May 24th. Two days later they made a flight to Philadelphia; loaded a Budd Skylounge aboard, then took off for the International Aeronautical and Space Show at Paris. (The Skylounge is a 23-passenger people-pod for local transportation of airline passengers by helicopter.) The flight was a huge success; the Budd Lounge and the Mini Guppy both got a fine reception from airshow visitors. Conroy also received a Medal of the City of Paris, an honor presented by Paris biennially to one person from each country in recognition of contributions to advancements in aerospace progress.

For Conroy himself the success lacked one element of triumph. Although he made the first flight in the Mini Guppy, he would have liked to have been at the controls when it sat down on the French runway. His chief pilot, Larry Engle, got that thrill, because Aero Spacelines stockholders thought it would dim the company's image if its president ferried the plane around. But there was a compensation. In speaking to us, Conroy made it clear that the reaction of shippers who saw the Mini Guppy at Paris assured the commercial success of this first model.

What Mini Guppy offers: Dimensions for carriage of big units of cargo, exceeding the dimensional capacity of any existing U.S. cargo plane, constitute the advantage the Mini Guppy offers you. It has a floor width of 13 feet, and an inside diameter of 18 feet 2 inches, which means that it can take a load with a cross-section of 13 by 13 feet. The uniform cross-section portion of the cargo compartment is 75 feet 10 inches long. Access to this compartment is by a swing tail, offering full opening without restriction. There is additional cargo space in the tapering tail, adding 23 feet 2 inches to the cargo compartment; this makes it possible to transport some loads longer than the 75 feet 10 inches of the uniform cross-section space.

For flight the swing tail is locked in place by hydraulically actuated guide pins and bolts. A retractable wheel supports the tail during loading. With this wheel in use, the height of the top of the fuselage from the ground is 27 feet 6 inches. Lifts of approximately 11 feet are required in loading.

Two Mini Guppy models: The data we have given for the Mini Guppy applies to the model being certified, which is powered by four Pratt & Whitney R-4360 3,500-s.h.p. piston engines. These produce a cruising speed of 250 m.p.h. with estimated payload of 18 tons.

Aero Spacelines expects to build another version

"WHAT I REALLY ENJOY IS DOING SOMETHING FIRST"

John M. Conroy does everything with a style all his own. He flew B-17's in the ETO, was shot down and spent six months as a POW in Germany, received the DFC, Air Medal, and Purple Heart. After the war he went into commercial airline flying, but continued military flying. In 1955 piloting an F-86 Saberjet he set the first round-trip transcontinental speed record, Los Angeles-New York-Los Angeles, between sunrise and sunset. Last year he repeated the feat with a Lear Jet to set the transcontinental speed record for business jet aircraft. He was the first to fly the Pregnant Guppy. He likes to recall how, in a test flight with Dr. Werner Von Braun, he feathered two engines with a full load, to demonstrate the Guppy's airworthiness. He says, "I don't get my kicks out of doing things other people have done. What I really enjoy is doing something first, something no one else has ever done before."

'GUPPY' MAKER THINKS HUGE - MAKES AIR HISTORY

By Tom Maurice

GOLETA - Aviation history is being made by a new company based at the Santa Barbara Municipal Airport here, but it was just a few short years ago that the prime mover of the company didn't know where his next nickle was coming from.

By now, many Santa Barbara area residents, and many from outside the county, have seen the huge "Guppies" based at the airport, and more recently many have watched in fascination as a new version of the Guppy line took shape under a giant frame canopy.

Fighting against time, John M. Conroy, President of Aero Spacelines, Inc., Santa Barbara, will exhibit the new "Mini-Guppy" at the International Air Show in Paris on May 26 - with a "little luck" thrown in.

At that same show, Conroy - who was fighting from day to day to get funds to put his first "Pregnant Guppy" over just four short years ago - will step up and receive a medal for the United States for greatest contribution by this country to aerospace in the last two years. The International Air Show is held every two years in Paris and it awards a medal to an individual from each major country, who has contributed most for his nation to the world of aerospace in the time since the show two years before.

The Paris air show will also bring special honors to Santa Barbara and thus to California. The Mini-Guppy was personally named "The Spirit of Santa Barbara" by Conroy for his own special reasons.

When he transferred his operation from the Van Nuys Airport to Santa Barbara Airport in 1966, Conroy came in for a great deal of criticism.

"I named the first Mini-Guppy the Spirit of Santa Barbara, first because I was criticized almost as much when we moved to Santa Barbara as I was when we decided to build the first Guppy," Conroy explained. "Secondly, critics said 'who ever heard of operating out of Santa Barbara, let alone trying to build an aircraft there.' Despite obvious shortcomings, the Mini-Guppy was built in less than six months. We started here with a handful of key people who knew their business and took on others and trained them. Our crew exhibited one heck of a lot of enthusiasm and ability. Building this plane from Dec. 12, 1966, is a phenomenal record."

Telling the story of Aero Spacelines must incorporate the story of Conroy and the type of individual he is. The stocky, youthful looking aerospace pioneer was born Dec. 14, 1920, in Buffalo, N. Y. and studied engineering at St. Gregory's College in Shawnee, Okla. He served in the Army Air Corps during World War II, and is the holder of the DFC, Air Medal and Purple Heart.

During World War II, he flew B-17 bombers in Europe, and on his 19th mission was shot down and spent six months as a prisoner of war in Germany.

After the war he went into commercial airline flying as well as military flying. He now has logged more than 18,000 hours flying time.

In 1955, he set the first round-trip transcontinental speed record, Los Angeles-New York-Los Angeles, between sunrise and sunset, flying an F-86 saberjet. In 1966, he duplicated the flight in a Lear Jet and established a transcontinental speed record for business jet aircraft.

Conroy flew in Central America and also had a fixed base operation in Blyth, Calif. In 1950, he started flying for supplemental airlines - nonscheduled lines.

"As a pilot you have quite a bit of time off. I was also operating a couple of other businesses on the side," Conroy said. "During this time, the thought occurred to me of having a fleet of converted Stratocruisers flying freight. I was a pilot in the Air National Guard in Van Nuys and had switched from jet fighters to C97s, the military component of the Boeing Stratocruiser. The Stratocruisers were available on the surplus market but most had been bought up by one man - Lee Mansdorf.

"I went to see him with my idea, and he said he would participate to the extent of supplying the planes, but wouldn't put up any money. We went out after financing and during this time came across an article in a magazine, which depicted the different concepts that had been proposed to the National Aeronautics and Space Administration for flying large pieces of hardware for NASA. All of the proposals for the Saturn rocket, particularly flying the second state, seemed unfeasible.

"Mansdorf came up with the idea of modifying a Stratocruiser to carry these outsized space vehicle parts, and I completed the final design. We raised capital, but in 1962, the stock market nose-dive wiped out our source of funds just when we were getting started. We went from week to week trying to make payroll, and found it very difficult to get money.

"The experts said the Pregnant Guppy wouldn't fly, but we kept on promoting the idea and finally got the Guppy to fly on Sept. 19, 1962. My original single investor, Loyd Dorsett, was from Oklahoma and we got quite a bit of additional capital from there and the rest from Southern California. All this time, the corporations commissioner was keeping a pretty close eye on us.

"Aero Spacelines, now a division of Unexcelled Corp., was formed in 1961. The company had no commitment of any kind and the Guppy was built strictly on speculation. We recognized the need and had many meetings with NASA. We felt if we flew the Guppy we would get a contract. The big question then was whether it was aerodynamically feasible to fly such a big craft. We could build the configuration to hold the missile parts, but we didn't know if we could fly it.

"We built the huge fuselage over the existing fuselage of the Stratocruiser just to prove it could fly. Once we flew it, we thought that financing from that point forward would be relatively simple, but NASA wouldn't give us a contract until we had the plane ready. NASA had been told their mission was to land a man on the moon by 1970, and that they had to stay out of the aircraft development business.

"Now the attitude of investors was 'you mean to say that after you've flown the plane you can't get a contract,' and so we had a heck of a time getting enough money to finish cutting up the plane, taking out the Stratocruiser fuselage and replacing it with the Guppy fuselage. But we just kept going and finally completed the Pregnant Guppy. NASA had been watching us all the time, and when we got FAA approval that the Guppy was aerodynamically sound, we finally got a NASA contract because they had a problem that the Guppy solved."

The Pregnant Guppy and the next larger version, the Super Guppy, have been on contract exclusively to NASA since 1963. Aero Spacelines has about 2-1/2 years to go on its latest contract that was for one year, with options for three additional years.

The Guppies have transported every section of the Saturn 5 to Cape Kennedy from contractors all over the nation.

The Pregnant Guppy had 200 inches of fuselage inserted after the wing. The Super Guppy, which had bigger re-

(See Spirit of, Page 2)

"FIRST FLIGHT OF PREGNANT GUPPY, SEPTEMBER 19, 1962, VAN NUYS, CALIFORNIA."

"FIRST FLIGHT OF SUPER GUPPY, AUGUST 31, 1965, VAN NUYS, CALIFORNIA."

(18 May 1968)

Conroy's Canadian "Guppy"

With double the capacity of the original Flying Tiger Canadair CL-44, from which it was converted, the Conroy Airlifter is claimed to be the largest-volume commercial pressurised cargo aircraft this side of the Iron Curtain. Flown for the first time on November 26 (see "Flight" for December 11, page 897) and designated CL-44-0, the aircraft is similar to the Guppy Stratocruiser adaptations, which were designed by Mr Jack Conroy. Conversion involved removing the upper half of the standard fuselage and adding prefabricated frames to expand the internal diameter to 13ft 11in. The Airlifter, which retains the swing tail, should be capable of accommodating out-size cargoes of up to 62,500lb in a hold 98ft 1in long—84ft of which is of constant section. Maximum internal height is now 11ft 4in and floor-level width 10ft 9in. Gross weight is estimated to be 210,000lb; max landing weight 165,000lb; max zero-fuel weight 160,000lb; and operating empty weight 97,500lb. The four 5,730 e.s.h.p. Tynes should give a 350 m.p.h. cruise. Conroy Aircraft, who built the Airlifter under licence from Canadair, hold options on three additional CL-44s. They expect FAA type certification early next year.

Mr Jack Conroy, president of the company bearing his name; Mr Herman Salmon, chief of flight testing; and Mr James Seymour, a CL-44 captain and instructor on loan from Flying Tiger

SIZE OF THE 94-foot Conroy Airlift dwarfs people on the ground as she was taxied out yesterday for her first flight. She has a swing tail for better loading of the 13-foot-wide cargo compartment, having been converted from smaller Canadair CL-44 here. She can fly anywhere in the world with her four Rolls-Royce turboprop engines.

CONROY CREATION

New Air Monster Passes Test With Flying Colors

A new air monster, the Conroy Airlift, the first of a series of converted Canadair Cl-44s, was poised on the northeast corner of the Santa Barbara Municipal Airport today, having completed its first flight successfully yesterday.

The new creation of Jack M. Conroy, president of the Conroy Aircraft Corp., has doubled the cubic capacity of the original Canadian-built plane with an 84-foot cargo compartment, having a maximum width of 13 feet, 11 inches, and a maximum height of 11 feet, four inches—which will airlift 62,500 pounds on four Rolls-Royce turboprop engines.

ORIGINAL GUPPIES

At the other end of the field are three original Aero Spacelines' Guppies and three more being built, which have cargo compartments 75 feet long and a maximum width of 18 feet, two inches, and a maximum height of 15 feet, six inches—and a payload of 60,000 pounds. (The Super Guppy has a 25-foot-in-diameter width and 108 feet in length.) These were also the concept developed by Conroy as founder and president of Aero Spacelines before he resigned to start the new firm at the same airport.

The new Conroy Airlift, with a swing tail for easier loading, was flown yesterday by Herman (Fish) Salmon, former Lockheed test pilot, and Capt. James Seymour, captain and instructor pilot with the Flying Tigers. Jeff Seideman was flight engineer and James Ross, flight test engineer.

LITTLE NOISE

It flew beautifully and with little noise as it made its first flight shortly after 11 a.m. yesterday, viewed by a crowd of company employes, visiting aviation industry people and the press.

The plane, given a special Federal Aviation Administration experimental flight ticket by Glen Lincoln, inspector, flew to Point Mugu, accompanied by other airplanes. Then, after tests there, the Conroy Airlift returned.

All concerned expressed themselves as "extremely satisfied" with the performance of the plane, which is pressurized and modifed under the terms of an exclusive licensing agreement with Canadair, Ltd.

FIRST OF SERIES

The CL-44-0, as Conroy has dubbed it, is to be the first of a series of special purpose cargo aircraft planned by the company. Conroy Aircraft purchased the CL-44 from the Flying Tiger Line and currently holds options for three additional CL-44s, according to Col. D. Lee Batten, USAF (ret), director of marketing and public relations.

The expanded fuselage will enable the aircraft to transport large jet engines, oil drilling equipment, airframes, space components and other items which, because of both size and weight, cannot be transported in any existing commercial cargo aircraft.

OTHERS IN FIRM

P. G. Smith, vice president for marketing and assistant to Conroy; Fred R. Atkins, vice president for administration and finance; R. W. Lillibridge, vice president for engineering and manufacturing, and Robert R. Kirby, director of research and development, are part of the corporation leadership that turned out the new plane.

In the group attending the first flight were Wayne Hoffman, Robert Prescott and William Gelfand, chairman of the board, president and treasurer of the Flying Tigers Line; M. E. Singleton Jr., president and chairman of the Capital Southwest Corp.; Tony Le Vier, 25-year veteran test pilot of Lockheed Aircraft Co., and many others from Southern California and Santa Barbara.

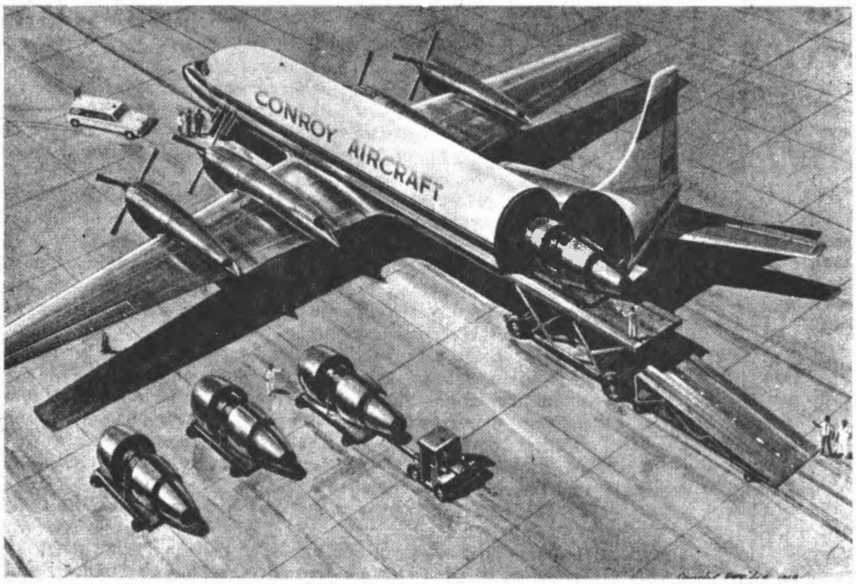
Conroy, since founding his new company here a year ago, has modified the DC-3 with Rolls-Royce Dart turboprop engines and created the "Stolifter," a new cargo-passenger aircraft designed for use from short landing strips. He is also planning to modify the C-119 "Flying Boxcar," with Rolls-Royce turboprop engines, for use with a 28-500-pound payload.

JET CARGO NEWS

THE JOURNAL OF PRODUCT MARKETING BY AIR

VOLUME ONE NUMBER SIXTEEN DECEMBER 23, 1969

Modified CL-44 air freighter will be enlarged by Conroy Aircraft Company of Santa Barbara, California, to accommodate outsized cargo. Work on the first CL-44 starts in January with maiden flight set for early May. See story, Page 7.



JOHN CONROY DOING HIS THING AGAIN: BUILDING BIGGER-THAN-LIFE CARGO PLANES

SANTA BARBARA—John Conroy figures the Boeing 747—world's largest commercial aircraft—is a nice plane except for one thing. It isn't big enough for modern air freight needs.

And plans are already fomenting in his mind to build a bigger one. Sound like an optimist with an uncontrollable imagination? That's what a lot of people said in the early '60s when Conroy set out to build his own airplane.

Today, he is known in the world of aviation as the man responsible for the Guppy family of giant cargo aircraft, owned now by Aero Space Lines. Guppy planes are greatly expanded versions of other aircraft. Conroy, now resigned from Aero Space, heads up the Conroy Aircraft Company here and is in the midst of building a fleet of airplanes to rival his original Guppy creations.

He announced earlier this month that preliminary arrangements for a licensing agreement between Conroy Aircraft Company and Canadair Ltd., manufacturer of the CL-44 air freighter, have been completed.

Under terms of the agreement, Canadair will provide Conroy Aircraft with CL-44 engineering data and the exclusive rights for the modification of the CL-44 into an outsized cargo-carrying aircraft. The modified CL-44 will be capable of accommodating large jet engines, air frames and other items too large to be transported in any existing aircraft.

Simultaneously, Conroy announced that negotiations have been completed with Flying Tiger Line to purchase a CL-44 with options for an additional three aircraft. Delivery of the first CL-44 to the Santa Barbara facility was scheduled last week, with actual modification to begin in January.

Conroy has assembled the same engineering staff that helped him design and build the original Guppy planes. The CL-44 will be reworked and expanded from its approximate maximum dimensions of seven feet in width to 14 feet, nine inches and from a maximum height now of about 11 feet to 11 feet, five inches. Its four Rolls-Royce engines will give it a cruising speed of about 225 m.p.h.

With engineering and pre-fabrication for the CL-44 already well underway, the first flight of the modified aircraft is planned for early May. Following initial flight testing, plans call for the aircraft to be displayed at the 1969 Paris Air Show.

The enlarged CL-44 will not match the size of the Super Guppy or the Pregnant Guppy which Conroy designed when he was with Aero Space. He is, in fact, prohibited by agreement from building planes any larger than his biggest Guppy Aircraft.

Although Conroy Aircraft Company refuses to discuss it right now, there is a legal suit pending to remove that restriction. It expires in July, 1970, regardless of the outcome of the suit.

In any case, Conroy is developing far-reaching plans to build all-cargo aircraft big enough to haul just about anything regardless of size. "So far as jet cargo planes are concerned, the company is thinking about the Air Force's B-52 and the Boeing 747," says Colonel D. L. Batten, Conroy's director of marketing. These planes, he explained, would serve as foundations for even bigger cargo aircraft.

Clearly, the sky—not John Conroy's imagination and engineering talent—is the only limit to bigger-than-life planes.

'Stolifter' Aircraft Takes Off, Lands in Only 300 Feet

BY MARVIN MILES
Times Aerospace Editor

SANTA BARBARA — A bright yellow airplane called a Stolifter lived up to its name on first flight here Thursday when it took off in less than 300 feet and landed in the same distance.

STOL, an acronym for short takeoff and landing, designates a new type of plane that may take its place between conventional aircraft and helicopters to help solve air traffic congestion and develop commute and air taxi services.

Featuring high lift devices and precise pilot control at slow takeoff and landing speeds, the STOL concept would offer flexible, low altitude operations from tiny stolports linked in a commuter network.

The ship tested Thursday is a modified Cessna 337 Skymaster, stretched and converted into an eight passenger STOL by Conroy Aircraft of Santa Barbara.

Pregnant Guppy Developer

John M. (Jack) Conroy, founder of the company, is the former president of Aero Spacelines, the man who dreamed up and made practical the enormous Pregnant Guppy and Super Guppy air freighters for space age cargo.

The Stolifter was tested by Clay Lacy, United Air Lines captain, who was somewhat surprised at the little plane's agility in jumping off the runway and landing for an almost abrupt stop.

Powered with a Garrett-AiResearch turbine, the twin-boom propeller plane lifted off the runway at 50 m.p.h. and landed at 44 m.p.h. At a gross weight of 4,700 pounds, Lacy estimated, it could have climbed over a 50-foot obstacle in 450 feet.

Conroy thinks the 250-m.p.h. plane will sell for about $85,000 as a commuter aircraft, an air taxi, a short-haul cargo carrier or a military utility aircraft.

L.A.Times 11/8/68

Conroy Plans Stretched Super Skymaster 337

Santa Barbara, Calif.—The prototype for a stretched, turboprop, single-engine version of the Cessna Super Skymaster 337 has been completed by Conroy Aircraft Co.

The aircraft was built under the supervision of John M. Conroy, founder and former head of Aero Spacelines, the company which designed and constructed the Pregnant Guppy and Mini Guppy cargo aircraft. Conroy resigned from Aero Spacelines in August 1967 and formed Conroy Aircraft last April.

First project of the new Conroy Aircraft Co. is the modified Super Skymaster, scheduled for its first flight in November. Powered by a single 575-hp Garrett-AiResearch TPE 331 engine, it will have seats for 10 persons and is designed to cruise at more than 225 mph. With the rear engine removed from the tandem-engine Super Skymaster, the stretched fuselage will have a hinged aft door for straight-in loading of passengers and cargo.

Reprint: AMERICAN AVIATIO
November 11, 196

SANTA BARBARA NEWS-PRESS

MONDAY EVENING, JUNE 8, 1970 C PAGE B-2

FAA Certificates Conroy's Giant CL-44 Freight Plane

Certification of the Conroy outsize CL-44, giant freight plane, by the Federal Aviation Administration was announced today by John M. Conroy, president of the Santa Barbara-based firm.

Designated the CL-44-0 "Airlifter," the new craft was awarded supplemental type certification following completion of a six-month flight test program. The certificate was awarded at Los Angeles International Airport Friday afternoon.

A modified Canadair CL-44, the plane is the largest commercial pressurized cargo aircraft in the free world and is capable of airlifting 62,500 pounds of cargo, Conroy said.

"Since our first flight in November, we have received inquiries from business firms and international carriers seeking to contract for the services of the aircraft," he reported. "This certification will enable us to put the aircraft to work immediately on a worldwide basis."

Modificaiton which doubled the cubic foot capacity of the original CL-44, increased the height from six feet, six inches to 11 feet, four inches and the maximum width from 10 feet, six inches to 14 feet.

The expanded fuselage, which has a swing tail to facilitate loading, will enable the aircraft to transport large jet engines, oil drilling equipment, air frames, space components and other items which, because of both size and weight, cannot be transported in any other existing commercial aircraft.

MODIFIED

Modified by Conroy Aircraft under the terms of an exclusive licensing agreement with Canadair, Ltd., Montreal, the CL-44-0 is the first of a series of special-purpose cargo aircraft planned by the company, Conroy added. The firm purchased the CL-44 from Flying Tiger Lines and currently holds options for three additional CL-44's.

Attending the award ceremony at Los Angeles were Wayne Hoffman, Flying Tigers chairman of the board; Robert Prescott, president; Conroy; Robert Lillibridge, Conroy Aircraft vice president, engineering and manufacturing; Marvin Singleton, Capital Southwest Corp., chairman and president, Dallas, Tex; Mel Decker, Capital Southwest chairman of the executive committee; and William Gelfand, Flying Tigers contract administration vice president. Rocco Lippis of the FAA Western Regional office made the award.

Canadair CL-44 with an enlarged fuselage is a candidate for airlifting Lockheed L-1011 engine pods from Britain to the U.S.

CL-44 Modified to Airlift L-1011 Pods

Santa Barbara, Calif.–Modified swing-tail Canadair CL-44 has emerged as a major candidate for the job of airlifting engine pods for the Lockheed L-1011 from the United Kingdom to the final assembly site at Palmdale, Calif.

The Conroy Aircraft Corp. CL-44-O—the "O" is for outsized fuselage—made a successful maiden flight Nov. 26.

The aircraft's development has been watched closely by Rolls-Royce, supplier of the RB.211 engines, Short Brothers and Harland, which builds the pods, and Lockheed-California Co. Officials of all three companies reportedly expressed considerable interest in the CL-44-O during recent visits.

Lockheed officials said they had been waiting for the first flight of the CL-44-O before selecting an operator. A Lockheed official said last week that a decision was imminent. Lockheed planned from the outset of the L-1011 program to airlift engines to Palmdale because of the long distance involved, but up to now has not found an acceptable carrier.

This contrasts with the use of railroads for transporting Pratt & Whitney JT9D powerplant packages to Everett, Wash., for use on the Boeing 747 giant jet transport.

Among the other candidates for the job of transporting L-1011 pods are the Lockheed L-100-20, civil version of the C-130, and possibly the Guppy aircraft owned by Aero Space Lines. John M. Conroy, president of Conroy Aircraft Co., was the original builder of the outsize Guppy, but later sold his interests.

The Guppies—in three different sizes, Mini, Super and Pregnant—are certified for hauling cargo too large for commercial aircraft such as the C-130. For this reason, a special exemption would have to be obtained to utilize the Guppies for the job.

Altogether 13 companies, including two scheduled carriers—Pan American and Seaboard World—responded to a Lockheed bid request issued Aug. 25. Bids were turned in Sept. 26. These included one by Conroy Aircraft to operate its CL-44-O.

Some of the bids were unresponsive in that Boeing 707 or Douglas DC-8 aircraft were suggested for hauling disassembled engines. Lockheed wants an aircraft which will haul one shipset of three engines per trip. This includes built-up wing pods 249 in. long, 118 in. wide and 103 in. high. The aft engine, which has no inlet duct has the same dimensions except for a 186-in. length.

Lockheed previously had selected the Canadian company, Pacific Western Airlines, to haul the engines in L-100s, but the British government turned thumbs down on the choice. The decision, more political than technical, centered on the theme that a carrier from either of the two countries involved in the program should perform the service.

Lockheed subsequently re-opened the competition and began looking more seriously at the CL-44, which had been designed for the role. Flying Tiger bought a 25% interest in Conroy Aircraft and made available ground handling equipment and personnel for the test program.

Flying Tiger owns a majority of the 39 CL-44 swing tail aircraft produced by Canadair and is interested in ensuring a market for them. Conroy bought one CL-44 from Flying Tiger and holds options on three more. An exclusive licensing agreement has been worked out between Conroy Aircraft and Canadair to permit the modification.

Principal change in the CL-44-O is an enlarged upper-lobe fuselage installed in place of the regular fuselage, which was removed with a cutting torch. Floor width and length remains the same. The change in upper lobe approximately doubles the internal volume of the aircraft.

Cargo Space

The new enlarged fuselage has a maximum width of 13 ft. 11 in. compared with a floor width of 10 ft. 9 in. Floor-to-ceiling height is 11 ft. 4 in. A special half-diamond fairing has been installed at the juncture of the aft wing and fuselage for strength. Weights, speeds and other dimensions remain the same as on the basic CL-44. Engines are Rolls-Royce Tyne turboprops rated at 5,730 shp. each

Never-exceed speed has been set at 283 kt. indicated air speed. This was reached on the first flight by former Lockheed test pilot, Herman R. Salmon. Salmon said stability about all three uxes was good.

No directional control problems were uncovered, and the stall speeds were "right on the money," Salmon said.

Copilot for the flight was James Seymour, a Flying Tiger captain and instructor pilot.

The CL-44-O will have a pressurized fuselage, the first time an outsized Conroy-manufactured aircraft has had this feature. All others have been unpressurized.

Test Program

Conroy plans a two-month flight test and certification program which would meet Lockheed's deadline for transporting the first RB.211 to the U.S. next April.

The all-up weight of a three-shipset load of L-1011 powerplants is 48,000 lb. including the heavy transportation dollies.

This is within the claimed 62,500 lb. payload capability of the CL-44-O.

Plans call for shipping 12 bare engines or pods in 1970. These will consist of singles and doubles from either Belfast or Darby.

First set of three engines will not be shipped until late December, 1970. The 1970 schedule calls for shipping a podded tail engine Apr. 1, two podded wing engines May 2, a podded tail engine Aug. 13, two podded wing engines Sept. 13, a bare engine Nov. 10, a podded wing engine Nov. 10, a bare engine Dec. 10 and a complete shipset Dec. 27.

Conroy CL-44-O Specifications

Powerplants	4 Rolls-Royce Tyne turboprop engines—5,730 eshp. each
Cruise speed	350 mph.
Estimated weights:	
Maximum gross takeoff	210,000 lb.
Maximum landing	165,000 lb.
Maximum zero fuel	160,000 lb.
Operating weight	97,500 lb.
Maximum payload	62,500 lb.
Cargo compartment dimensions:	
Maximum width (floor level)	10 ft. 9 in.
Maximum width	13 ft. 11 in.
Maximum height	11 ft. 4 in.
Length (constant section)	84 ft. 0 in.
Length (overall)	98 ft. 1 in.